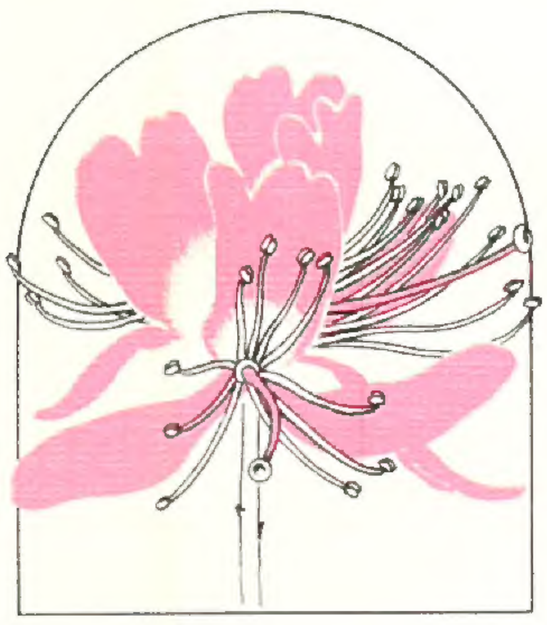

RHODORA

The Journal of the
New England Botanical Club

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Vol. 98 **Winter, 1996** **No. 893**

Issued: April 23, 1997

The New England Botanical Club, Inc.

22 Divinity Avenue, Cambridge, Massachusetts 02138

RHODORA

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RHODORA (ISSN 0035-4902). Published four times a year (January, April, July, and October) by The New England Botanical Club, 810 East 10th St., Lawrence, KS 66044 and printed by Allen Press, Inc., 1041 New Hampshire St., Lawrence, KS 66044-0368. Periodicals postage paid at Lawrence, KS. POSTMASTER: Send address changes to RHODORA, P.O. Box 1897, Lawrence, KS 66044-8897.

RHODORA is a journal of botany devoted primarily to the flora of North America. Monographs or scientific papers concerned with systematics, floristics, ecology, paleobotany, or conservation biology of the flora of North America or floristically related areas will be considered.

SUBSCRIPTIONS: $75 per calendar year, net, postpaid, in funds payable at par in United States currency. Remittances payable to RHODORA. Send to RHODORA, P.O. Box 1897, Lawrence, KS 66044-8897.

MEMBERSHIPS: Regular $35; Family $45; Student $25. Application form printed herein.

NEBC WEB SITE: Information about The New England Botanical Club, its history, officers and councillors, herbarium, monthly meetings and special events, annual graduate student award, and the journal RHODORA is available at http://www.herbaria.harvard.edu/nebc/

BACK ISSUES: Information on availability of back issues should be addressed to Dr. Cathy A. Paris, Department of Botany, University of Vermont, Burlington, VT 05405-0086. E-mail: cparis@moose.uvm.edu.

ADDRESS CHANGES: In order to receive the next number of RHODORA, changes must be received by the business office prior to the first day of January, April, July, or October.

INFORMATION FOR CONTRIBUTORS: See contents. Submit manuscripts to the Editor-in-Chief.

♾ This paper meets the requirements of ANSI/NISO Z39.48-1992 (Permanence of Paper).

RHODORA, Vol. 98, No. 893, pp. 1–79, 1996

ATLAS OF THE FLORA OF NEW ENGLAND: PTERIDOPHYTES AND GYMNOSPERMS

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ABSTRACT. Dot maps are provided to depict the distribution at the county level of the pteridophytes (Lycopodiophyta, Equisetophyta, Polypodiophyta) and gymnosperms (Coniferophyta) growing outside of cultivation in the six New England states of the northeastern United States. The 171 taxa (species, subspecies, varieties and hybrids, but not forms) are mapped at the county level based on specimens in the major herbaria of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut, with primary emphasis on the holdings of the New England Botanical Club Herbarium (NEBC). Brief synonymy to account for names used in recent manuals and floras for the area, habitat and chromosome information and common names also are provided.

Key Words: Flora, New England, atlas, distribution, pteridophytes, gymnosperms

This article is the first in a series that will present the distributions of the vascular flora of New England in the form of dot distribution maps at the county level. New England comprises the six northeastern states of the United States: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut. These states range in latitude from 41°N to 47°28′N and in longitude from 67°W to 73°45′W. The elevation of the region extends from sea level to 1,898 m (6,228 ft.) at the summit of Mt. Washington, New Hampshire, the highest mountain in eastern North America outside of North Carolina. The total area of the region is 172,515 km^2 (66,608 $mi.^2$) including bodies of water; the total land area is 163,157 km^2 (62,995 $mi.^2$). The effects of continental glaciers, which covered the entire region several times during the Pleistocene, and the last of which did not retreat until about 15,000 years ago, are still clearly evident throughout the area. The state by state statistics on size and elevation are shown in Table 1 (Merriam-Webster, Inc. 1984).

Table 1. Total area, land area, and range in elevation for the six New England states.

	Total Area	Land Area	Elevation Range
Maine	86,028 km^2	80,117 km^2	0–1,606 m
New Hampshire	24,097 km^2	23,395 km^2	0–1,898 m
Vermont	24,887 km^2	24,020 km^2	29–1,339 m
Massachusetts	21,386 km^2	20,287 km^2	0–1,064 m
Rhode Island	3,144 km^2	2,725 km^2	0–248 m
Connecticut	12,973 km^2	12,613 km^2	0–725 m

The more southerly states of Massachusetts, Rhode Island, and Connecticut are densely populated (the least densely populated of these three states, Connecticut, had an average of 262 persons per km^2 in 1990; Hoffman 1992). The northern states of Maine, New Hampshire, and Vermont are mostly rural (the most densely populated of these three states, New Hampshire, had an average of 48 persons per km^2 in 1990; Hoffman 1992).

This work encompasses all vascular plants (pteridophytes and spermatophytes) at the rank of species, subspecies, and variety growing outside of cultivation in the New England states. Hybrids also will be included, but forms and other ranks below the level of variety will not. The dots are based primarily on voucher specimens in the herbaria of New England representing reproducing populations, or plants persisting after cultivation when it is uncertain that they are actually naturalized. This first installment includes the pteridophytes (Lycopodiophyta, Equisetophyta, Polypodiophyta) and gymnosperms (Coniferophyta). Future accounts will treat the distribution of angiosperms.

We intend to gather this series of articles, together with additional background material, into a separate volume upon completion of all the maps, and to make it available on the World Wide Web as various parts are finished. It is our hope that, in the meantime, these articles will stimulate additional field work to supplement the distributions portrayed in the maps. The New England Botanical Club herbarium, which has proven to be the most important resource for this project, is especially eager to receive specimens documenting range extensions. We also would like to be informed of such specimens in other herbaria. Similarly, because the atlas of the New England flora will be continuously updated as new information becomes available, we are eager to receive notification of published corrections of cytological infor-

mation and new, documented chromosome counts for taxa in the New England flora.

MATERIALS AND METHODS

This atlas grew out of an inventory of the New England Botanical Club vascular plant herbarium. The purpose of the inventory, conducted at the county level, was to serve as a filter for the processing of a large number of unmounted specimens being considered for accession. Consequently, the core of the database for this atlas consists of specimens in the herbarium of vascular plants of the New England Botanical Club (NEBC). The NEBC herbarium, which limits its geographical scope to the New England states, presently comprises more than 251,000 specimens and is the largest collection of plants for the New England region.

In the mid 1980s the herbarium inventory was expanded into an atlas project, since data from the NEBC herbarium essentially depict the distributions of the vascular plants of New England. Additional data from specimens in other major herbaria with large holdings of New England plants have allowed us to portray the distributions more completely.

The data represented currently by specimens in New England herbaria best depict vascular plant distributions when displayed at the county level. Attempting to display such data by the exact geographical coordinates of each collection locality, or even at the township level, distorts the actual distributions. By such detailed mapping, patterns tend to reflect concentrated collecting along major highways and clustering near popular resort areas or botanical hot spots. This was evident from some of the detailed distribution maps produced about 15 years ago by the plant distribution committee (now defunct) of the New England Botanical Club. The distortions portrayed by such detailed mapping are resolved by using data only at the county level.

The counties of New England range in size from Bristol County, Rhode Island (65 km^2, or 25 $mi.^2$), to Aroostook County, Maine (17,666 km^2, or 6821 $mi.^2$—land only). The great majority of counties, however, are between 1300 km^2 (500 $mi.^2$) and 3900 km^2 (1500 $mi.^2$). To reduce the size disparity at the large end, and to depict distributions more evenly, the largest Maine counties are subdivided. Penobscot, Piscataquis, Somerset, and Oxford Counties are divided arbitrarily into roughly equal-sized, north and

south sectors along township boundaries. Aroostook County, the largest county, is divided into three sectors. Coös County, New Hampshire, is divided into north and south sectors. The division of Coös County isolates the White Mountains, which harbor an alpine flora associated mostly with New England's highest peak, Mount Washington. Figure 1 shows the location of states and counties of New England and the subdivisions of the largest counties.

Data were collected primarily from herbarium specimens of major herbaria in New England. The herbaria used to compile data for this work were those of the New England Botanical Club (NEBC), Harvard University (A, AMES, GH), University of Maine (MAINE), University of Massachusetts (MASS), University of New Hampshire (NHA), University of Rhode Island (KIRI), University of Vermont (VT), and Brown University (BRU). Records from the herbaria at the University of Connecticut (CONN), Connecticut Botanical Society (NCBS), and Yale University (YU) were accessed from data compiled by Leslie Mehrhoff. Lastly, the notebooks of Harry Ahles at the University of Massachusetts were consulted. Ahles visited these same herbaria, plus one or two others, in the 1960s and 1970s to gather locality information at the county level. We obtained some records from systematic treatments where the information on voucher specimens was specific enough to provide county data and the name of the herbarium where the specimens were deposited.

In recording the collection data no attempt was made to verify the accuracy of the identification of every specimen, but obvious misidentifications were annotated with corrections. Even though the basis for a particular dot might be a misidentified specimen, for plants common within New England, our view is that the taxon most likely occurs within the county. Specimens documenting disjunct or marginal occurrences (or otherwise rare, endangered or threatened taxa) usually have received greater scrutiny, because of a heightened interest in rare plants nationwide, and are less likely to be misidentified.

The data were entered into a simple computer database using one of several letters in the county field as a code to indicate the herbarium in which the voucher specimen is deposited. The letter code indicates the first herbarium where a voucher specimen was seen. No letter codes were added for subsequent voucher specimens at other herbaria, because our primary objective has been to plot the distribution of the taxon, not to inventory the holdings

of any particular herbarium. While such information might be of value for some purposes, we felt that our time at other herbaria was best devoted to searching for data not found in the New England Botanical Club herbarium, or in each subsequently searched herbarium, to fill in gaps in distribution.

The data in the database were converted to dot distribution maps using a method devised by Angelo (1994). A more detailed and technical description of the mapping methodology will appear as an appendix in the final volume. Interested parties may obtain a draft of the appendix upon request to the first author.

TAXONOMY AND FORMAT

The taxonomy and nomenclature adopted for this work essentially follow the *Flora of North America* (Flora of North America Editorial Committee 1993). With the exception of the arrangement for the major divisions within the pteridophytes (Lycopodiophyta, Equisetophyta, and Polypodiophyta), which follows the *Flora of North America* (Flora of North America Editorial Committee 1993) sequence, the families are ordered alphabetically. The genera are alphabetical within families, as are species within genera. Named and unnamed hybrid taxa are placed alphabetically at the end of the genus. Unnamed hybrids combine the names of the progenitors alphabetically by epithet.

Species deemed to be introduced, that is, not native in New England at the time of European contact with North America, are indicated by the use of all upper case type for the scientific name. No single source of information was used in determining introduced species. For most taxa there is little dispute as to nativity. Where differences of opinion exist in the literature, we have used our own judgment based on the evidence available.

A common name is supplied when it appears to be a name in general use. Names used in New England have been given preference.

Cited chromosome numbers are taken from indices prepared by Cave (1958a, 1958b, 1959a, 1959b, 1960, 1961, 1962, 1963, 1964, 1965), Goldblatt (1981, 1984, 1985, 1988), Goldblatt and Johnson (1990, 1991, 1994), Moore (1973, 1974, 1977), Ornduff (1967, 1968, 1969), and reports by Takamiya and Kurita (1983), Taylor (1970), Tryon (1978), Tryon and Tryon (1982), and Wagner (1971). Very few of the counts are based on material from

New England, but instead reflect counts made from throughout the range of the taxon.

The habitat data are distillations from a variety of sources augmented by our own field observations. An attempt was made to indicate habitat information as it applies to a particular taxon in New England rather than to the entire range of the taxon.

Synonymy is provided primarily with respect to names used in the standard manuals covering New England published from 1950 onward, including Fernald (1950), Gleason (1952), Gleason and Cronquist (1963, 1991), and Seymour (1969a, 1982).

A selection of references, including many not cited above, is provided. This list consists of the standard manuals published from 1950 to date, regional and county floras and checklists produced after 1950, and what we believe to be the key articles and books on the pteridophytes and gymnosperms pertinent to New England. We would appreciate being notified of papers we may have overlooked.

LYCOPODIOPHYTA

ISOETACEAE

Isoëtes acadiensis Kott—Acadian Quillwort (Figure 2). $2n = 44$; the report of $2n = 44$ (Kott and Britton 1980) for *I. macrospora* Durieu forma *hieroglyphica* (A. A. Eaton) N. E. Pfeiffer was later attributed (Kott 1981) to *I. acadiensis*. Shallow water of ponds and slow moving streams.

Isoëtes echinospora Durieu—Braun's Quillwort (Figure 2). $2n = 22, 33$. Shallow water and shores of slightly acidic lakes, ponds, and streams. [*I. echinospora* var. *braunii* (Durieu) Engelmann; *I. echinospora* var. *muricata* (Durieu) Engelmann; *I. muricata* Durieu]

Isoëtes engelmannii A. Braun—Engelmann's Quillwort (Figure 2). $n = 11$; $2n = 22$. Shallow water of ponds, lakes, streams, or in muddy ditches.

Isoëtes lacustris Linnaeus—Lake Quillwort (Figure 2). $2n = 110$. Shores and shallow water of slightly acidic ponds, lakes, and streams. [*I. macrospora* Durieu; *I. hieroglyphica* A. A. Eaton]

Isoëtes prototypus D. M. Britton (Figure 3). $2n = 22$. Deep water of cold, acidic lakes.

Isoëtes riparia Engelmann ex A. Braun—Riverbank Quillwort (Figure 3). $2n = 44$. Muddy or sandy shores (including tidal shores and estuaries), usually of rivers. [*I. riparia* var. *canadensis* Engelmann; *I. saccharata* Engelmann var. *amesii* A. A. Eaton]

Isoëtes tuckermanii A. Braun ex Engelmann—Tuckerman's Quillwort (Figure 3). $2n = 44$. Pond and lake margins, shores (frequently tidal), usually submersed in quiet water.

—*Isoëtes* Hybrids—

Isoëtes × *eatonii* Dodge (Figure 3). [= *I. echinospora* Durieu × *I. engelmannii* A. Braun; *I.* × *gravesii* A. A. Eaton; *I. eatonii* Dodge var. *gravesii* (A. A. Eaton) Clute]

Isoëtes × *harveyi* A. A. Eaton. This hybrid was recognized only recently by Britton (1991). Herbarium specimens annotated as this hybrid are from southern Penobscot Co., Maine (US); Somerset Co., Maine (MAINE); and Mt. Desert Island, Maine (MO). Since the holdings of NEBC have not been examined critically for this hybrid, it is not mapped. [= *I. lacustris* Linnaeus × *I. tuckermanii* A. Braun]

LYCOPODIACEAE

Diphasiastrum complanatum (Linnaeus) Holub—Northern Running Pine (Figure 4). $n = 22$–$24, 23$; $2n = 40, 44, 46, 48$. Dry, open coniferous or mixed forests. [*Lycopodium complanatum* Linnaeus]

Diphasiastrum digitatum (Dillenius ex A. Braun) Holub—Southern Running Pine (Figure 4). $n = 23$; $2n = 46$. Usually dry woods, thickets, or open fields, in acid soils. [*Lycopodium complanatum* Linnaeus var. *flabelliforme* Fernald]

Diphasiastrum sitchense (Ruprecht) Holub—Sitka Clubmoss (Figure 4). $n = 23$; $2n = 46$. Alpine meadows, open rocky

barrens, conifer woods (rarely). [*Lycopodium sitchense* Ruprecht]

Diphasiastrum tristachyum (Pursh) Holub—Ground Cedar (Figure 4). $n = 23$; $2n = 46$. Acid soils in open conifer or oak woods, thickets. [*Lycopodium tristachyum* Pursh]

—*Diphasiastrum* Hybrids—

Diphasiastrum alpinum (Linnaeus) Holub × *Diphasiastrum complanatum* (Linnaeus) Holub (Figure 5).

Diphasiastrum complanatum (Linnaeus) Holub × *Diphasiastrum digitatum* (Dillenius ex A. Braun) Holub (Figure 5).

Diphasiastrum digitatum (Dillenius ex A. Braun) Holub × *Diphasiastrum* × *sabinifolium* (Willdenow) Holub (Figure 5).

Diphasiastrum × *habereri* (House) Holub (Figure 5). [= *D. digitatum* (Dillenius ex A. Braun) Holub × *D. tristachyum* (Pursh) Holub; *Lycopodium* × *habereri* House]

Diphasiastrum × *issleri* (Rouy) Holub (Figure 6). [= *D. alpinum* (Linnaeus) Holub × *D. tristachyum* (Pursh) Holub; *Lycopodium* × *issleri* (Rouy) Lawalrèe]

Diphasiastrum × *sabinifolium* (Willdenow) Holub—Savin-leaved Clubmoss (Figure 6). $2n = 46$. Woods (often subalpine spruce), thickets, clearings. [= *D. sitchense* (Ruprecht) Holub × *D. tristachyum* (Pursh) Holub; *Lycopodium sabinifolium* Willdenow]

Diphasiastrum × *zeilleri* (Rouy) Holub (Figure 6). [= *D. complanatum* (Linnaeus) Holub × *D. tristachyum* (Pursh) Holub]

Huperzia appalachiana Beitel & Mickel (Figure 6). Cliffs, talus slopes, damp, acidic rocks in alpine zones. [Specimens mapped are from the herbaria of the New England Botanical Club and Harvard University.]

Huperzia lucidula (Michaux) Trevisan—Shining Clubmoss (Figure 7). $n = 67$; $2n = 134$. Cool, moist woods in rich and acid soils. [*Lycopodium lucidulum* Michaux]

Huperzia selago (Linnaeus) Bernhardi ex Schrank & Martius—Mountain Clubmoss (Figure 7). $n = 136$II; $2n = 268$. Damp rocks, barrens, cold woods, in mountainous regions. [*H. selago* var. *densa* Trevisan; *Lycopodium selago* Linnaeus; *Lycopodium selago* Linnaeus var. *appressum* Desvaux]

—*Huperzia* Hybrids—

Huperzia appalachiana Beitel & Mickel × *Huperzia lucidula* (Michaux) Trevisan (Figure 7).

Huperzia appalachiana Beitel & Mickel × *Huperzia selago* (Linnaeus) Bernhardi ex Schrank & Martius (Figure 7).

Huperzia × *buttersii* (Abbe) Kartesz & Gandhi (Figure 8). [= *H. lucidula* (Michaux) Trevisan × *H. selago* (Linnaeus) Bernhardi ex Schrank & Martius]

Lycopodiella alopecuroides (Linnaeus) Cranfill—Foxtail Clubmoss (Figure 8). $2n = 156$. Bogs, marshes, ditches, sandy or peaty shores, wet barrens, in acid soils. [*Lycopodium alopecuroides* Linnaeus]

Lycopodiella appressa (Chapman) Cranfill—Appressed Bog Clubmoss (Figure 8). $2n = 156$. Damp, acid or peaty soils in the open. [*Lycopodium appressum* (Chapman) Lloyd & Underwood; *Lycopodium inundatum* Linnaeus var. *bigelovii* Tuckerman; *Lycopodium inundatum* Linnaeus var. *robustum* R. J. Eaton]

Lycopodiella inundata (Linnaeus) Holub—Bog Clubmoss (Figure 8). $n = 78$; $2n = 156$. Damp, acid, sandy or peaty soils in the open. [*Lycopodium inundatum* Linnaeus]

Lycopodiella margueritae J. G. Bruce, W. H. Wagner & Beitel (Figure 9). $2n = 312$.

Lycopodium annotinum Linnaeus—Stiff Clubmoss (Figure 9). $n = 34, 68II$; $2n =$ ca. 50, 66, 68. Woods, cool shaded thickets, exposed rocky or peaty habitats at higher elevations. [*L. annotinum* var. *acrifolium* Fernald; *L. annotinum* var. *alpestre* C. Hartman; *L. annotinum* var. *pungens* (Bachelot de la Pylaie) Desvaux]

Lycopodium clavatum Linnaeus—Staghorn Clubmoss (Figure 9). $n = 22, 34, 34II, 34III, 34IV, 68$ (69, 70); $2n = 34, 44, 68, 102, 136$. Open, usually dry, woods and thickets, clearings, exposed rocky situations, in acid soils. [*L. clavatum* var. *subremotum* Victorin]

Lycopodium dendroideum Michaux—Tree Clubmoss (Figure 9). $2n = 68$. Dry, open woods and clearings. [*L. obscurum* Linnaeus var. *dendroideum* (Michaux) D. C. Eaton]

Lycopodium hickeyi W. H. Wagner, Beitel & R. C. Moran—Hickey's Clubmoss (Figure 10). $2n = 68$. Mainly deciduous woods and thickets, usually in acid soils. [*L. obscurum* Linnaeus var. *isophyllum* Hickey]

Lycopodium lagopus (Laestadius ex C. Hartman) G. Zinserling ex Kuzeneva-Prochorova (Figure 10). $2n = 68$. Grassy fields and openings in second-growth woods. [*L. clavatum* Linnaeus var. *megastachyon* Fernald & Bissell; *L. clavatum* Linnaeus var. *monostachyon* Hooker & Greville] Distribution data are primarily from the herbaria of the New England Botanical Club and Harvard University.

Lycopodium obscurum Linnaeus—Tree Clubmoss (Figure 10). $n = 34, 34II$; $2n = 68$. Rich woods, clearings, edges of boggy forests, usually in acid soils.

—*Lycopodium* Hybrids—

Lycopodium dendroideum Michaux × *Lycopodium obscurum* Linnaeus (Figure 10).

Pseudolycopodiella caroliniana (Linnaeus) Holub—Carolina Clubmoss (Figure 11). $n = 35, 68, 70, 115$; $2n = 70, 78, 140$.

Damp, open sands and peat in acid soils. [*Lycopodium carolinianum* Linnaeus]

SELAGINELLACEAE

Selaginella apoda (Linnaeus) Spring—Meadow Spikemoss (Figure 11). $2n = 18$. Meadows, stream banks, moist lawns, wet rocks, often in circumneutral soils. [*S. eclipes* W. R. Buck]

Selaginella rupestris (Linnaeus) Spring—Rock Spikemoss (Figure 11). $2n = 18$. Exposed, dry rocks or packed sands.

Selaginella selaginoides (Linnaeus) Palisot de Beauvois ex Martius & Schrank—Northern Spikemoss (Figure 11). $2n = 18$. Damp shores and banks, bogs, springs, often calcareous.

EQUISETOPHYTA

EQUISETACEAE

Equisetum arvense Linnaeus—Field Horsetail (Figure 12). $n = 108$; $2n = 200+, 216$. Open, low ground, roadsides, damp, open woods and thickets. [*E. arvense* var. *boreale* (Bongard) Ruprecht]

Equisetum fluviatile Linnaeus—Water Horsetail (Figure 12). $n = 108$; $2n = 216$. Shores, shallow water of pond and river margins, swales.

Equisetum hyemale Linnaeus subsp. *affine* (Engelmann) Calder & Roy L. Taylor—Common Scouring Rush (Figure 12). $n = 108$. Sandy banks and shores, alluvium, moist wooded slopes, roadsides. [*E. hyemale* var. *affine* (Engelmann) A. A. Eaton; *E. hyemale* var. *pseudohyemale* (Farwell) C. V. Morton]

Equisetum palustre Linnaeus—Marsh Horsetail (Figure 12). $n = 108$. Shores, flooded meadows, swamps, and marshes.

Equisetum pratense Ehrhart—Meadow Horsetail (Figure 13). $n = 108$; $2n = 216$. Rich slopes in humus-rich neutral soils, meadows, alluvial thickets.

Equisetum scirpoides Michaux—Dwarf Scouring Rush (Figure 13). $n = 108$. Well-drained slopes, in cool woods, frequently under *Tsuga*, often growing in moss.

Equisetum sylvaticum Linnaeus—Wood Horsetail (Figure 13). $2n = 216$. Cool moist woods, swamps, around springs. [*E. sylvaticum* var. *pauciramosum* Milde]

Equisetum variegatum Schleicher ex F. Weber & D. Mohr—Variegated Horsetail (Figure 13). $2n = 216$. Riverbanks, shores, bog margins, moist gravel, and damp, calcareous sands.

—*Equisetum* Hybrids—

Equisetum × *ferrissii* Clute (Figure 14). Sandy shores, embankments, roadsides. [= *E. hyemale* Linnaeus × *E. laevigatum* A. Braun; *E. hyemale* Linnaeus var. *intermedium* A. A. Eaton; *E. hyemale* Linnaeus var. *elatum* (Engelmann) C. V. Morton]

Equisetum × *litorale* Kuhlewein ex Ruprecht—Shore Horsetail (Figure 14). Shores, ditches, meadows. [= *E. arvense* Linnaeus × *E. fluviatile* Linnaeus]

Equisetum × *mackaii* (Newman) Brichan (Figure 14). $2n = 432$. Riverbanks, shores, bog margins, gravelly areas, damp, calcareous sands. [= *E. hyemale* Linnaeus × *E. variegatum* Schleicher ex F. Weber & D. Mohr; *E.* × *trachyodon* (A. Braun) Koch; *E. variegatum* Schleicher ex F. Weber & D. Mohr var. *jesupii* A. A. Eaton]

POLYPODIOPHYTA

ASPLENIACEAE

Asplenium montanum Willdenow—Mountain Spleenwort (Figure 14). $2n = 72$. Moist, sheltered crevices of chiefly non-calcareous cliffs and ledges.

Asplenium platyneuron (Linnaeus) Britton, Sterns & Poggenburg—Ebony Spleenwort (Figure 15). $n = 36$, 36II. Well-drained, rocky, circumneutral soils on slopes and ledges in deciduous forests (occasionally on crumbling mortar). [*A. platyneuron* var. *incisum* (E. C. Howe) B. L. Robinson]

Asplenium rhizophyllum Linnaeus—Walking Fern (Figure 15). $n = 36$. Shaded, basic or circumneutral rocks, rarely on earth or at tree bases. [*Camptosorus rhizophyllus* (Linnaeus) Link]

Asplenium ruta-muraria Linnaeus—Wall-rue (Figure 15). $n = 36$, 72; $2n = 144$. Shaded crevices of calcareous cliffs and ledges. [*A. cryptolepis* Fernald; *A. ruta-muraria* var. *cryptolepis* (Fernald) Wherry]

Asplenium trichomanes Linnaeus—Maidenhair Spleenwort (Figure 15). $n = 36$, 36II, 36II + 36I, 72, 81, 108, 144; $2n = 72$, 144, ca. 216. Shaded crevices of mainly calcareous rocks (occasionally on crumbling mortar). [*A. trichomanes* subsp. *quadrivalens* D. E. Meyer]

Asplenium trichomanes-ramosum Linnaeus—Green Spleenwort (Figure 16). $n = 36$; $2n = 72$. Shaded, moist crevices and talus of calcareous and serpentine rocks and outcrops. [*A. viride* Hudson]

—*Asplenium* Hybrids—

Asplenium × *clermontae* Syme (Figure 16). 3x = 108. [= *A. ruta-muraria* Linnaeus × *A. trichomanes* Linnaeus]

Asplenium × *ebenoides* R. R. Scott—Scott's Spleenwort (Figure 16). $2n = 72$, 144. [= *A. platyneuron* (Linnaeus) Britton, Sterns & Poggenburg × *A. rhizophyllum* Linnaeus; × *Asplenosorus ebenoides* (R. R. Scott) Wherry]

AZOLLACEAE

AZOLLA CAROLINIANA Willdenow—Mosquito Fern (Figure 16). $n = 48$; $2n = 44$, 66. Floating in quiet waters. From south of our range.

BLECHNACEAE

Woodwardia areolata (Linnaeus) T. Moore—Netted Chain Fern (Figure 17). $n = 35$. Swamps and boggy woods in acid soils.

Woodwardia virginica (Linnaeus) Smith—Virginia Chain Fern (Figure 17). $n = 35$, ca. 36. Acid swamps, bogs, and wet, wooded bottoms.

DENNSTAEDTIACEAE

Dennstaedtia punctilobula (Michaux) T. Moore—Hay-scented Fern (Figure 17). $n =$ ca. 33, 34. Open woods, roadsides, stream banks, pastures and rocky slopes in sterile soils.

Pteridium aquilinum (Linnaeus) Kuhn subsp. *latiusculum* (Desvaux) Hultén—Bracken (Figure 17). $n = 52$; $2n = 104$. Clearings, pastures, burns, thickets and woods, usually in dry, sterile soils. [*P. aquilinum* var. *latiusculum* (Desvaux) L. Underwood ex A. Heller]

Pteridium aquilinum (Linnaeus) Kuhn subsp. *pseudocaudatum* (Clute) Hultén—Bracken (Figure 18). Same habitats as in subsp. *latiusculum*. [*P. aquilinum* var. *pseudocaudatum* (Clute) A. Heller]

DRYOPTERIDACEAE

Athyrium filix-femina (Linnaeus) Roth ex Mertens subsp. *angustum* (Willdenow) R. T. Clausen—Lady Fern (Figure 18). $n = 40$; $2n = 80$. Moist woods, thickets, ravines, fields, meadows and swamps. [*A. filix-femina* var. *angustum* (Willdenow) G. Lawson; *A. filix-femina* var. *michauxii* (Sprengel) Farwell]

Athyrium filix-femina (Linnaeus) Roth ex Mertens subsp. *asplenioides* (Michaux) Hultén—Southern Lady Fern (Figure 18). $2n = 80$. Moist woods, thickets, swamps, meadows. [*A. filix-femina* var. *asplenioides* (Michaux) Farwell]

Cystopteris bulbifera (Linnaeus) Bernhardi—Bulblet Fern (Figure 18). $n = 42$; $2n = 42$. Calcareous, usually moist, ledges, steep banks, rocky slopes, and ravines.

Cystopteris fragilis (Linnaeus) Bernhardi—Fragile Fern (Figure 19). $n = 42, 84, 126$; $2n = 168$. Moist rocks, rocky (mostly wooded) slopes.

Cystopteris laurentiana (Weatherby) Blasdell. $n = 126$; $2n = 252$. Cliffs, often calcareous. [*C. fragilis* (Linnaeus) Bernhardi var. *laurentiana* Weatherby] Distribution data were not collected for this taxon, since it was generally not distinguished from *C. fragilis* (Linnaeus) Bernhardi in New England herbaria.

Cystopteris protrusa (Weatherby) Blasdell—Southern Bladder Fern (Figure 19). $n = 42, 63$. Moist, often calcareous, wooded slopes, rocky banks, and alluvium. [*C. fragilis* (Linnaeus) Bernhardi var. *protrusa* Weatherby]

Cystopteris tenuis (Michaux) Desvaux—Mackay's Fragile Fern (Figure 19). $n = 84$; $2n = 168$. Moist, shaded rocks, rocky (mostly wooded) slopes, alluvium, open woods. [*C. fragilis* (Linnaeus) Bernhardi var. *mackayi* G. Lawson]

—*Cystopteris* Hybrids—

Cystopteris fragilis (Linnaeus) Bernhardi × *Cystopteris tenuis* (Michaux) Desvaux (Figure 19). $n = 53II + 60I + 2III$, $53I + 56I + 2\ III$, $52I + 64I$. Dry to moist cliffs and talus, moist ravines. Information for this hybrid is from Paler and Barrington (1995).

Deparia acrostichoides (Swartz) M. Kato—Silvery Spleenwort (Figure 20). $n = 40$; $2n = 80$. Rich moist woods, bottomlands, shaded slopes. [*Athyrium thelypterioides* (Michaux) Desvaux; *Diplazium acrostichoides* (Swartz) Butters]

Diplazium pycnocarpon (Sprengel) M. Broun—Narrow-leaved Spleenwort (Figure 20). $n = 40$. Moist, mostly calcareous, wooded slopes, ravines, and bottoms. [*Athyrium pycnocarpon* (Sprengel) Tidestrom; *Homalosorus pycnocarpos* (Sprengel) Small ex Pichi-Sermolli]

Dryopteris campyloptera (Kunze) Clarkson—Mountain Wood Fern (Figure 20). $n = 82$; $2n = 164$. Moist, cool woods, thickets, and banks. [*D. austriaca* (Jacquin) Woynar ex Schinz & Thellung var. *austriaca; D. spinulosa* (O. F. Mueller) Watt var. *americana* (Fischer ex Kunze) Fernald; *D. spinulosa* (O. F. Mueller) Watt var. *concordiana* (Davenport) Eastman; *D. austriaca* (Jacquin) Woynar ex Schinz & Thellung var. *concordiana* (Davenport) Morton]

Dryopteris carthusiana (Villars) H. P. Fuchs—Spinulose Wood Fern (Figure 20). $n = 82$; $2n =$ ca. 160, 164. Low, moist (occasionally dry) woods and thickets, stream banks, swamps. [*D. austriaca* (Jacquin) Woynar ex Schinz & Thellung var. *spinulosa* (O. F. Mueller) Fiori; *D. spinulosa* (O. F. Mueller) Watt]

Dryopteris cristata (Linnaeus) A. Gray—Crested Wood Fern (Figure 21). $n = 41, 82, 123$; $2n = 82, 164$. Swamps, wet woods, marshes, boggy thickets.

Dryopteris filix-mas (Linnaeus) Schott—Male Fern (Figure 21). $n = 82, 83$; $2n = 41, 164$. Rocky wooded slopes, cold ravines, rich woods, upland pastures in chiefly calcareous soil, trap, or slate.

Dryopteris fragrans (Linnaeus) Schott—Fragrant Cliff Fern (Figure 21). $n = 41, 42$. Dry, often north-facing and calcareous, cliffs, ledges, talus, and rocky banks. [*D. fragrans* var. *remotiuscula* Komarov]

Dryopteris goldiana (Hooker ex Goldie) A. Gray—Goldie's Fern (Figure 21). $n = 41$; $2n = 41$. Rich, moist woods, rocky slopes (mostly calcareous), ravines.

Dryopteris intermedia (Muhlenberg ex Willdenow) A. Gray—Glandular Wood Fern (Figure 22). $n = 41$; $2n = 82$. Moist, rocky woods and moist thickets. [*D. austriaca* (Jacquin) Woynar ex Schinz & Thellung var. *intermedia* (Muhlenberg ex Willdenow) C. V. Morton; *D. spinulosa* (O. F. Mueller) Watt var. *intermedia* (Muhlenberg ex Willdenow) L. Underwood]

Dryopteris marginalis (Linnaeus) A. Gray—Marginal Shield Fern (Figure 22). $n = 41$. Rocky, usually rich, wooded slopes, ravines.

—*Dryopteris* Hybrids—

Dryopteris × *benedictii* Wherry (Figure 22). [= *D. carthusiana* (Villars) H. P. Fuchs × *D.* × *clintoniana* (D. C. Eaton) Dowell]

Dryopteris × *boottii* (Tuckerman) Underwood—Boott's Wood Fern (Figure 22). $n = 82, 123$; $2n = 123$. Moist woods and thickets in mildly acid soils. [= *D. cristata* (Linnaeus) A. Gray × *D. intermedia* (Willdenow) A. Gray]. This common and widespread hybrid is not treated in *Flora of North America* (Flora of North America Editorial Committee 1993).

Dryopteris × *burgessii* Boivin (Figure 23). [= *D.* × *clintoniana* (D. C. Eaton) Dowell × *D. marginalis* (Linnaeus) A. Gray]

Dryopteris campyloptera (Kunze) Clarkson × *Dryopteris intermedia* (Muhlenberg ex Willdenow) A. Gray (Figure 23).

Dryopteris campyloptera (Kunze) Clarkson × *Dryopteris marginalis* (Linnaeus) A. Gray (Figure 23).

Dryopteris carthusiana (Villars) H. P. Fuchs × *Dryopteris goldiana* (Hooker ex Goldie) A. Gray (Figure 23). There is one known collection for this taxon. Other collections so identified are variations of *D. goldiana* (report in preparation, W. H. Wagner, Jr., pers. comm.).

Dryopteris × *clintoniana* (D. C. Eaton) Dowell—Clinton's Wood Fern (Figure 24). $n = 123$; $2n = 246$. Wet (rarely only moist), often circumneutral woods and swamps. [=*D. cristata* (Linnaeus) A. Gray × *D. goldiana* (Hooker ex Goldie) A. Gray; *D. cristata* (Linnaeus) A. Gray var. *clintoniana* (D. C. Eaton) L. Underwood]

Dryopteris × *clintoniana* (D. C. Eaton) Dowell × *Dryopteris cristata* (Linnaeus) A. Gray (Figure 24).

Dryopteris × *clintoniana* (D. C. Eaton) Dowell × *Dryopteris filix-mas* (Linnaeus) Schott (Figure 24).

Dryopteris × *clintoniana* (D. C. Eaton) Dowell × *Dryopteris goldiana* (Hooker ex Goldie) A. Gray (Figure 24).

Dryopteris × *dowellii* (Farwell) Wherry (Figure 25). [= *D.* × *clintoniana* (D. C. Eaton) Dowell × *D. intermedia* (Muhlenberg ex Willdenow) A. Gray]

Dryopteris filix-mas (Linnaeus) Schott × *Dryopteris marginalis* (Linnaeus) A. Gray (Figure 25).

Dryopteris goldiana (Hooker ex Goldie) A. Gray × *Dryopteris intermedia* (Muhlenberg ex Willdenow) A. Gray (Figure 25).

Dryopteris intermedia (Muhlenberg ex Willdenow) A. Gray × *Dryopteris marginalis* (Linnaeus) A. Gray (Figure 25).

Dryopteris × *neowherryi* W. H. Wagner (Figure 26). [= *D. goldiana* (Hooker ex Goldie) A. Gray × *D. marginalis* (Linnaeus) A. Gray]

Dryopteris × *pittsfordensis* Slosson (Figure 26). [= *D. carthusiana* (Villars) H. P. Fuchs × *D. marginalis* (Linnaeus) A. Gray]

Dryopteris × *slossoniae* Wherry ex Lellinger (Figure 26). [= *D. cristata* (Linnaeus) A. Gray × *D. marginalis* (Linnaeus) A. Gray]

Dryopteris × *triploidea* Wherry (Figure 26). $3n = 123$. Rocky or swampy (often rich) woods. [= *D. carthusiana* (Villars) H. P. Fuchs × *D. intermedia* (Muhlenberg ex Willdenow) A. Gray; *D. austriaca* (Jacquin) Woynar ex Schinz & Thellung var. *fructuosa* (Gilbert) C. V. Morton; *D. spinulosa* (O. F. Mueller) Watt var. *fructuosa* (Gilbert) Trudell]. This common and widespread hybrid is not treated in *Flora of North America* (Flora of North America Editorial Committee 1993).

Dryopteris × *uliginosa* (A. Braun ex Dowell) Druce (Figure 27). [= *D. carthusiana* (Villars) H. P. Fuchs × *D. cristata* (Linnaeus) A. Gray]

Gymnocarpium dryopteris (Linnaeus) Newman—Oak Fern (Figure 27). $n = 40$, ca. 73, 80; $2n = 80$, 160. Cool, moist, often rocky, woods and banks. [*Dryopteris disjuncta* (Ruprecht) C. V. Morton (misapplied)]

Gymnocarpium jessoense (Koidzumi) Koidzumi subsp. *parvulum* Sarvela—Nahanni Oak Fern (Figure 27). $2n = 80, 160$. Acid or neutral substrates of cool talus slopes, cliffs, and outcrops. This taxon also is reported to occur in Connecticut in *Flora of North America* (Flora of North America Editorial Committee 1993), but neither specimens nor specific citations of specimens in the literature have been seen. Kathleen Pryer (pers. comm.) indicates that the Connecticut report may be based on a mislabeled specimen.

Matteuccia struthiopteris (Linnaeus) Todaro—Ostrich Fern (Figure 27). $n = 39, 40$; $2n = 78$. Alluvium, bottomland thickets, swamps, and moist woods, often in circumneutral soils. [*M. pensylvanica* (Willdenow) Raymond; *M. struthiopteris* var. *pensylvanica* (Willdenow) C. V. Morton; *Pteretis pensylvanica* (Willdenow) Fernald]

Onoclea sensibilis Linnaeus—Sensitive Fern (Figure 28). $n = 37$; $2n = 74$. Swamps, low woods, alluvial thickets, meadows, in neutral to slightly acid soils. [*O. sensibilis* var. *obtusilobata* (Schkuhr) Torrey]

Polystichum acrostichoides (Michaux) Schott—Christmas Fern (Figure 28). $n = 41$; $2n = 82$. Rocky woods and slopes, occasionally swamps.

Polystichum braunii (Spenner) Fée—Braun's Holly Fern (Figure 28). $n = 82$; $2n = 164$. Cool, damp, rocky woods, ravines, and banks in circumneutral soils. [*P. braunii* var. *purshii* Fernald; *P. braunii* subsp. *purshii* (Fernald) Calder & Roy L. Taylor]

—*Polystichum* Hybrids—

Polystichum × *potteri* Barrington (Figure 28). $n = 71I + 26II$, $74I + 23II + 1III$, $77I + 23II$, $79I + 22II$, $81I + 21II$, $85I + 19II$, $87I + 18II$. [= *P. acrostichoides* (Michaux) Schott × *P. braunii* (Spenner) Fée]

Woodsia alpina (Bolton) S. F. Gray—Northern Woodsia (Figure 29). $n = 82$; $2n = 156$, 164. Cool, calcareous (sometimes slaty) rock crevices. [*W. alpina* var. *bellii* Lawson]

Woodsia glabella R. Brown ex Richardson—Smooth Woodsia (Figure 29). $n = 39$, ca. 40, ca. 82; $2n = 78$, ca. 80. Moist, shaded crevices of calcareous rocks.

Woodsia ilvensis (Linnaeus) R. Brown—Rusty Woodsia (Figure 29). $n = 39$, 41; $2n = 78$, 82. Dry, often exposed, cliffs and talus.

Woodsia obtusa (Sprengel) Torrey—Blunt-lobed Woodsia (Figure 29). $n = 76$. Shaded ledges and rocky woods, mostly in calcareous soils.

—*Woodsia* Hybrids—

Woodsia × *gracilis* (Lawson) Butters (Figure 30). [= *W. alpina* (Bolton) S. F. Gray × *W. ilvensis* (Linnaeus) R. Brown]

HYMENOPHYLLACEAE

Trichomanes intricatum Farrar—Appalachian Bristle Fern (Figure 30). Sheltered, moist, noncalcareous rock crevices and other protected places in deep ravines and gorges. Known only as gametophytes.

LYGODIACEAE

Lygodium palmatum (Bernhardi) Swartz—Climbing Fern (Figure 30). $n = 30$. Damp thickets and woods, stream banks, in acid soils.

MARSILEACEAE

MARSILEA QUADRIFOLIA Linnaeus—Water Clover (Figure 30). $n = 20$; $2n = 40$. Lakes, ponds, and quiet streams. From Europe.

OPHIOGLOSSACEAE

Botrychium dissectum Sprengel—Cut-leaved Grape Fern (Figure 31). $n = 45$. Woods, open thickets, clearings, sandy barrens. [*B. dissectum* Sprengel var. *obliquum* (Muhlenberg ex Willdenow) Clute]

Botrychium lanceolatum (S. G. Gmelin) Ångström subsp. *angustisegmentum* (Pease & A. H. Moore) R. T. Clausen —Triangle Grape Fern (Figure 31). $n = 45$; $2n = 90$. Moist, cool, rich woods, swamp margins, meadows, peaty slopes, clearings. [*B. lanceolatum* var. *angustisegmentum* Pease & A. H. Moore]

Botrychium lunaria (Linnaeus) Swartz—Common Moonwort (Figure 31). $n = 45$; $2n = 90$. Open, gravelly or rocky slopes, pastures, meadows, shores, chiefly in calcareous soils.

Botrychium matricariifolium (Döll) A. Braun ex W. D. J. Koch—Daisyleaf Grape Fern (Figure 31). $n = 90$. Rich, usually moist, deciduous woods and thickets.

Botrychium minganense Victorin—Mingan Moonwort (Figure 32). $n = 90$; $2n = 180$. Habitats similar to those of *B. lunaria*. [*B. lunaria* (Linnaeus) Swartz forma *minganense* (Victorin) Clute; *B. lunaria* var. *minganense* (Victorin) Dole]

Botrychium multifidum (S. G. Gmelin) Ruprecht—Leathery Grape Fern (Figure 32). $n = 45$; $2n = 90, 180$. Peaty, sandy, or gravelly slopes, sparse woods, thickets, clearings, usually in acid soils. [*B. multifidum* var. *intermedium* (D. C. Eaton) Farwell]

Botrychium oneidense (Gilbert) House—Oneida Grape Fern. $n = 45$; $2n = 90$. Moist, acidic woods and swamps. [*B. dissectum* Sprengel var. *oneidense* (Gilbert) Farwell; *B. multifidum* (S. G. Gmelin) Ruprecht var. *oneidense* (Gilbert) Farwell]. Distribution data were not collected for this taxon as it was inadequately distinguished from *B. dissectum* Sprengel and *B. multifidum* (S. G. Gmelin) Ruprecht in New England herbaria.

Botrychium pallidum W. H. Wagner. $2n = 90$. A species reported in *Flora of North America* (Flora of North America Editorial

Committee 1993) as occurring in Maine; no voucher seen, no specific voucher for New England cited.

Botrychium rugulosum W. H. Wagner (Figure 32). $n = 45$. Open fields and secondary forests. We found no annotated vouchers for this relatively recently recognized taxon in New England herbaria. The distribution data are taken from W. H. Wagner, Jr., and F. S. Wagner (1982).

Botrychium simplex E. Hitchcock—Least Grape Fern (Figure 32). $n = 45$. Meadows, moist woods, edges of swamps and pastures, open shores, usually in poor soils. [*B. simplex* var. *tenebrosum* (A. A. Eaton) R. T. Clausen]

Botrychium virginianum (Linnaeus) Swartz—Rattlesnake Fern (Figure 33). $n = 92$; $2n = 184$. Rich woods and thickets in neutral to slightly acid soils. [*B. virginianum* var. *europaeum* Ångström]

Ophioglossum pusillum Rafinesque—Northern Adder's Tongue (Figure 33). $n = 480$; $2n = 960$. Peaty or grassy swales, meadows, damp thickets, damp sands. [*O. vulgatum* Linnaeus var. *pseudopodum* (S. F. Blake) Farwell]

OSMUNDACEAE

Osmunda cinnamomea Linnaeus—Cinnamon Fern (Figure 33). $n = 22$. Swamps, damp thickets, stream banks, and other moist, shaded places in acid soils. [*O. cinnamomea* var. *glandulosa* Waters]

Osmunda claytoniana Linnaeus—Interrupted Fern (Figure 33). $n = 22$; $2n = 44$. Moist woods, margins of swamps, moist thickets, occasionally in the open, in acid or neutral soils.

Osmunda regalis Linnaeus var. *spectabilis* (Willdenow) A. Gray—Royal Fern (Figure 34). $n = 22$; $2n = 44$. Swamps, peaty thickets, shores, meadows, bogs, mostly in acid soils.

—*Osmunda* Hybrids—

Osmunda cinnamomea Linnaeus × *Osmunda claytoniana* Linnaeus (Figure 34).

Osmunda × *ruggii* R. M. Tryon (Figure 34). [= *O. claytoniana* Linnaeus × *O. regalis* Linnaeus var. *spectabilis* (Willdenow) A. Gray]

POLYPODIACEAE

Polypodium appalachianum Haufler & Windham—Appalachian Polypody (Figure 34). $n = 37$; $2n = 74$. Cliffs and rocky slopes. [Data are from the herbaria of the New England Botanical Club and Harvard University.]

Polypodium virginianum Linnaeus—Common Polypody (Figure 35). $n = 74$; $2n = 148$. On rocks, cliffs, tree bases, rocky (occasionally sandy) slopes, usually in acid soils. [*P. vulgare* Linnaeus var. *virginianum* (Linnaeus) D. C. Eaton]

PTERIDACEAE

Adiantum aleuticum (Ruprecht) Paris—Aleutian Maidenhair Fern (Figure 35). $n = 29$. Serpentine barrens. [*A. pedatum* Linnaeus var. *aleuticum* Ruprecht; *A. pedatum* subsp. *calderi* Cody]

ADIANTUM HISPIDULUM Swartz. $n = 171$. A species from Asia reported in *Flora of North America* (Flora of North America Editorial Committee 1993) as escaped in Connecticut; no voucher seen, no specific voucher for New England cited.

Adiantum pedatum Linnaeus—Common Maidenhair Fern (Figure 35). $n = 29$, 58II, 57II + 2I, 56II + R4, 56II + chIV, 54I + 2II; $2n = 58$, 60. Rich, deciduous woods, in circumneutral or basic soil.

—*Adiantum* Hybrids—

Adiantum × *viridimontanum* Paris (Figure 35). $n = 58$. [= *A. aleuticum* (Ruprecht) Paris × *A. pedatum* Linnaeus]

Cheilanthes lanosa (Michaux) D. C. Eaton—Hairy Lip Fern (Figure 36). $n = 30$. Rocks and cliffs, calcareous or siliceous. [*C. vestita* (Sprengel) Swartz]

Cryptogramma stelleri (S. G. Gmelin) Prantl—Slender Cliff-brake (Figure 36). $n = 30$. Shaded, moist, calcareous cliffs and rock ledges, typically in coniferous woods.

Pellaea atropurpurea (Linnaeus) Link—Purple Cliff-brake (Figure 36). $n = 87$. Dry, exposed, calcareous rocks (occasionally on crumbling mortar), trap rock.

Pellaea glabella Mettenius ex Kuhn—Smooth Cliff-brake (Figure 36). $n = 116$. Dry, calcareous rocks and cliffs.

SALVINIACEAE

SALVINIA NATANS (Linnaeus) Allioni—Floating Fern (Figure 37). $n = 18$; $2n = 18, 36$. On still waters of ponds or slow streams. From Europe and Asia. [Records from New England are likely to be misidentified as *S. rotundifolia* Willdenow (Nauman 1993)]. This species is mentioned, but not treated in *Flora of North America* (Flora of North America Editorial Committee 1993).

THELYPTERIDACEAE

Phegopteris connectilis (Michaux) Watt—Long Beech Fern (Figure 37). $n = 60, 90$; $2n = 90$. Rich, damp woods, cool, shaded, rocky banks, moist cliffs. [*Dryopteris phegopteris* (Linnaeus) C. Christensen; *Thelypteris phegopteris* (Linnaeus) Slosson]

Phegopteris hexagonoptera (Michaux) Fée—Broad Beech Fern (Figure 37). $2n = 60$. Rich woods and thickets. [*Dryopteris hexagonoptera* (Michaux) C. Christensen; *Thelypteris hexagonoptera* (Michaux) Nieuwland]

Thelypteris noveboracensis (Linnaeus) Nieuwland—New York Fern (Figure 37). $n = 27$. Moist woods and thickets. [*Dryopteris noveboracensis* (Linnaeus) A. Gray]

Thelypteris palustris Schott var. *pubescens* (Lawson) Fernald—Marsh Fern (Figure 38). $n = 35$. Swamps, low damp thickets, meadows, marshes, bogs, along ditches and streams. [*Dryopteris thelypteris* (Linnaeus) A. Gray var. *pubescens* (Lawson) Weatherby]

Thelypteris simulata (Davenport) Nieuwland—Massachusetts Fern (Figure 38). $n = 64$. Swampy or boggy woods and thickets, on knolls in bogs, in acid soils. [*Dryopteris simulata* Davenport]

CONIFEROPHYTA

CUPRESSACEAE

Chamaecyparis thyoides (Linnaeus) Britton, Sterns & Poggenburg—Atlantic White Cedar (Figure 38). Swamps, wet thickets.

Juniperus communis Linnaeus var. *depressa* Pursh—Ground Juniper (Figure 38). $2n = 22$. Poor soils in open areas, especially old pastures and ledges, persisting in recent woodlands. [Larger individuals have been misidentified as var. *communis*.]

Juniperus horizontalis Moench—Creeping Juniper (Figure 39). $2n = 22$. Ledges, sandy or rocky banks.

Juniperus virginiana Linnaeus—Eastern Red Cedar (Figure 39). Mostly dry, open sites (typically old fields), rocky slopes, bor-

ders of salt marshes, persisting in recent woodlands. [*J. virginiana* var. *crebra* Fernald & Griscom]

—*Juniperus* Hybrids—

Juniperus communis Linnaeus var. *depressa* Pursh × *Juniperus virginiana* Linnaeus (Figure 39).

Juniperus horizontalis Moench × *Juniperus virginiana* Linnaeus (Figure 39).

Thuja occidentalis Linnaeus—Arbor-vitae (Figure 40). $2n = 22$. Swamps, rocky banks of ponds and rivers, old pastures, in calcareous soils.

PINACEAE

Abies balsamea (Linnaeus) Miller—Balsam Fir (Figure 40). $2n = 24$. Damp, rich, cool woods, swamps, mountain slopes. [*A. balsamea* var. *phanerolepis* Fernald]

LARIX DECIDUA Miller—European Larch (Figure 40). $2n = 24$. Near habitations in moist woods and clearings. From Europe.

Larix laricina (Du Roi) K. Koch—Tamarack (Figure 40). $n = 12$; $2n = 24$. Northward in poorly drained lowlands, swamps, bogs, shaded hillsides, sometimes to tree line on mountain slopes; southward in cold swamps and bogs.

PICEA ABIES (Linnaeus) H. Karsten—Norway Spruce (Figure 41). $n = 12$; $2n = 24$. Woods and hedgerows. From Europe.

Picea glauca (Moench) Voss—White Spruce (Figure 41). $n = 12$; $2n = 24$. Moist woods, dry sandy soils, old pastures, rocky slopes, exposed hilltops, ocean cliffs.

Picea mariana (Miller) Britton, Sterns & Poggenburg—Black Spruce (Figure 41). $n = 12$; $2n = 24$. Northward on mountain slopes, rocky hillsides, high banks of streams, bogs; southward in sphagnum bogs and swamps.

Picea rubens Sargent—Red Spruce (Figure 41). $n = 12$; $2n = 24$. Rocky, well-drained, upland woods, mountain slopes, occasionally in swamps (southward).

Pinus banksiana Lambert—Jack Pine (Figure 42). $2n = 18, 24$. Sterile sand or rocky soils, rocky slopes and ledges, escaped from plantations at roadsides and bog margins (southward).

PINUS MUGO Turra—Swiss Mountain Pine (Figure 42). $2n = 24$. Old pastures. From Europe. *PINUS MUGO* is not treated in *Flora of North America* (Flora of North America Editorial Committee 1993).

PINUS NIGRA Arnott—Austrian Pine (Figure 42). $2n = 18, 24$. From Europe. *PINUS NIGRA* is mentioned, but not treated in *Flora of North America* (Flora of North America Editorial Committee 1993).

Pinus resinosa Aiton—Red Pine (Figure 42). $2n = 24$. Sandy or gravelly soil in dry woods and barrens, mountain slopes, ledges, occasionally in peat bogs.

Pinus rigida Miller—Pitch Pine (Figure 43). $2n = 24$. Dry, sterile, sandy or gravelly soils, rocky slopes, occasionally in cold swamps and bogs.

Pinus strobus Linnaeus—Eastern White Pine (Figure 43). $n = 12$; $2n = 24$. Sandy or fertile, well-drained soils, but tolerating wet ground (rarely in bogs).

PINUS SYLVESTRIS Linnaeus—Scotch Pine (Figure 43). $n = 12$; $2n = 24$. Roadsides, fallow fields, dry woods. From Eurasia. Our plants are apparently all var. *SYLVESTRIS*.

PINUS THUNBERGII Parlatore—Japanese Black Pine (Figure 43). $n = 12$; $2n = 24$. Dry sandy soils. From Asia. *PINUS THUNBERGII* is mentioned, but not treated in *Flora of North America* (Flora of North America Editorial Committee 1993).

Tsuga canadensis (Linnaeus) Carrière—Eastern Hemlock (Figure 44). $n = 12$; $2n = 24$. Cool moist slopes, ravines, moist woods, swamps, mucky soils near ponds and streams.

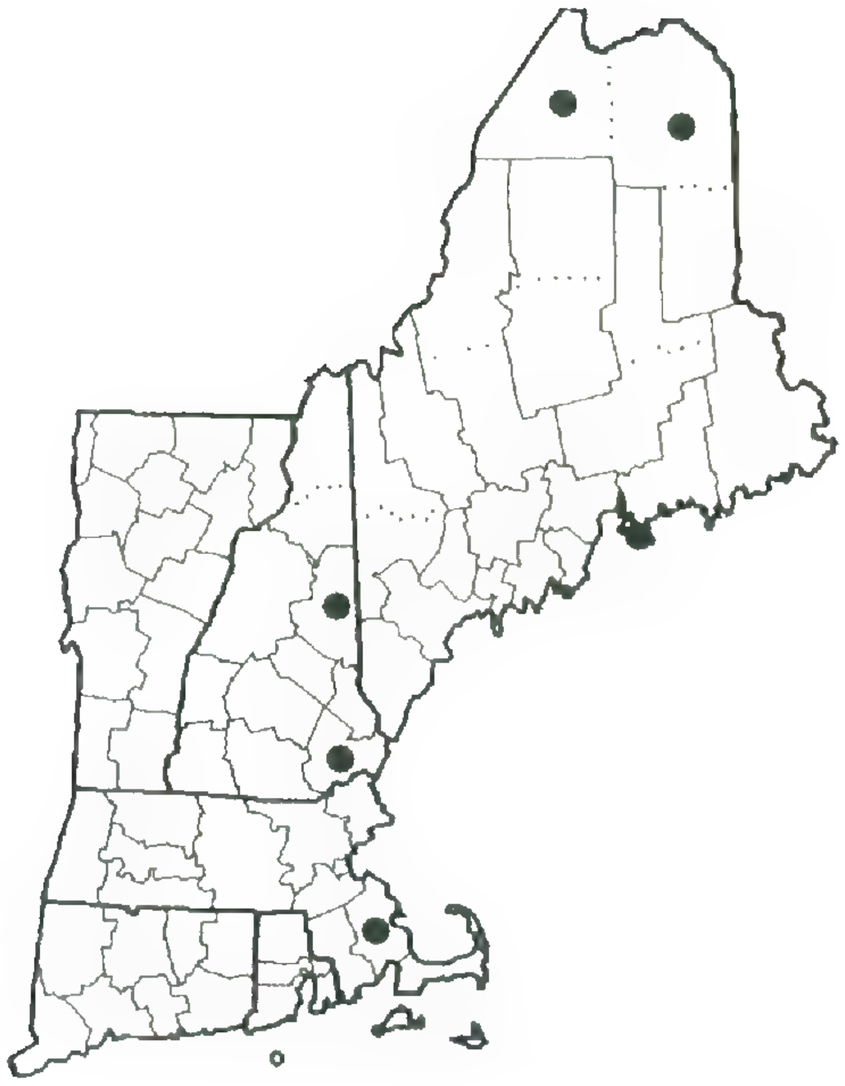
TAXACEAE

Taxus canadensis Marshall—American Yew (Figure 44). $2n = 24$. Damp, rich, or swampy woods, mostly in the shade of conifers, ravines and near streams, occasionally on moist, rocky slopes at higher elevations.

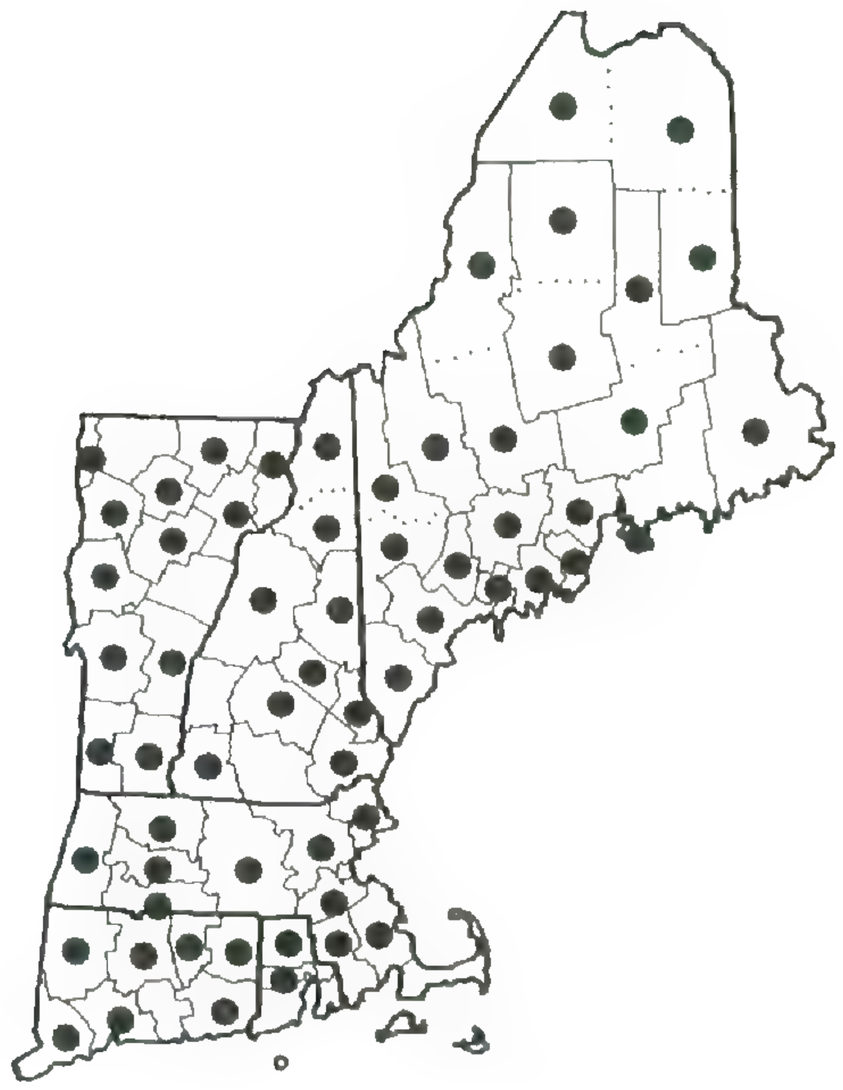
TAXUS CUSPIDATA Siebold & Zuccarini—Japanese Yew (Figure 44). From Asia. *TAXUS CUSPIDATA* is mentioned but not treated in *Flora of North America* (Flora of North America Editorial Committee 1993).

ACKNOWLEDGMENTS. We thank the curators and directors of the herbaria of Brown University, Harvard University, the University of Maine, University of Massachusetts, the University of New Hampshire, the University of Rhode Island, and the University of Vermont for allowing us access to their collections. We particularly appreciate the kindness of David Barrington, Chris Campbell and Karen Searcy for allowing use of the collections in their care outside of normal hours of operation. We are grateful also to Karen Searcy for allowing access to the notebooks of Harry E. Ahles at the University of Massachusetts. Leslie J. Mehrhoff was very generous in sharing data on pteridophytes and gymnosperms that he has collected from the herbaria at the University of Connecticut and Yale University. James Hinds assisted by checking the University of Maine herbarium for some discrepancies in the Harry Ahles data. Thomas Vining, at the University of Maine, checked additional specimen data for us at that institution. David Barrington, David S. Conant, and James Hickey made many helpful comments on various versions of the manuscript and Warren H. "Herb" Wagner was particularly helpful and encouraging. Lastly, we thank Bruce A. Sorrie for collecting data from the Harvard University herbaria in the early stages of this project.

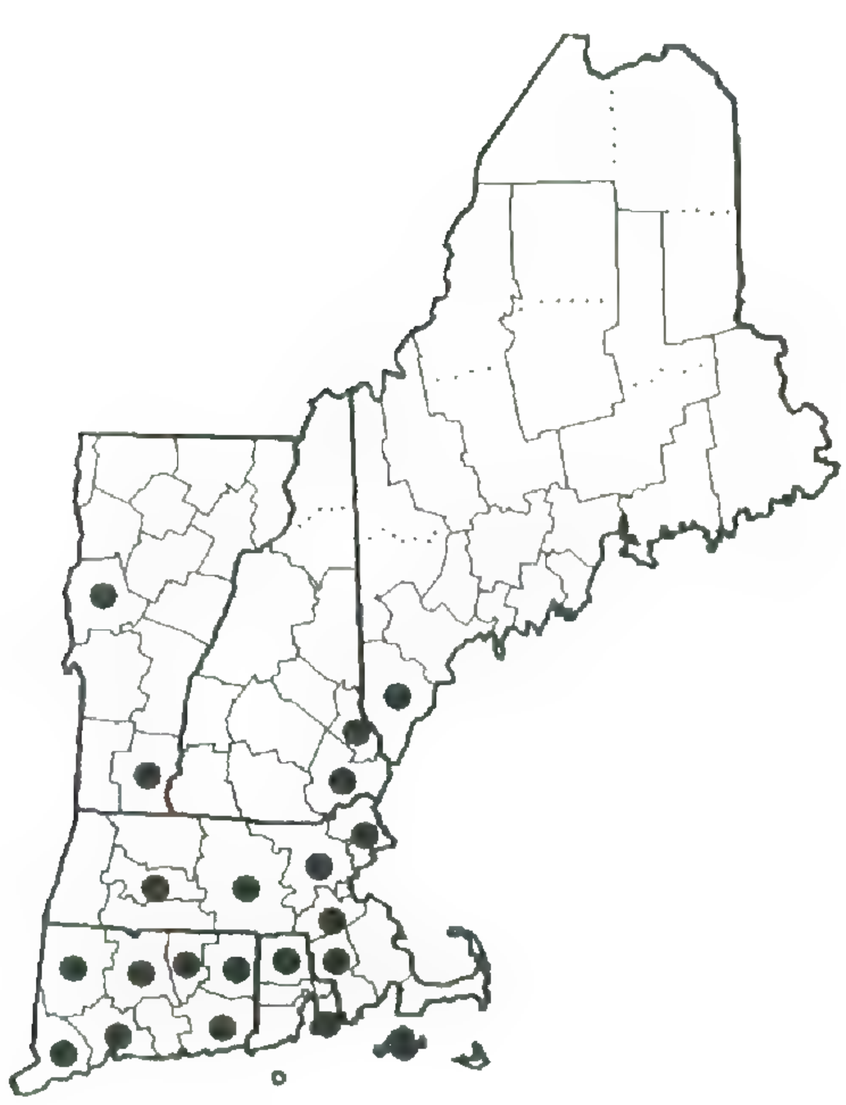
Figure 1. Key map for counties of the New England states (and Mt. Desert Island, Maine and Block Island, Rhode Island and arbitrary divisions of larger Maine counties and Coös County, New Hampshire).



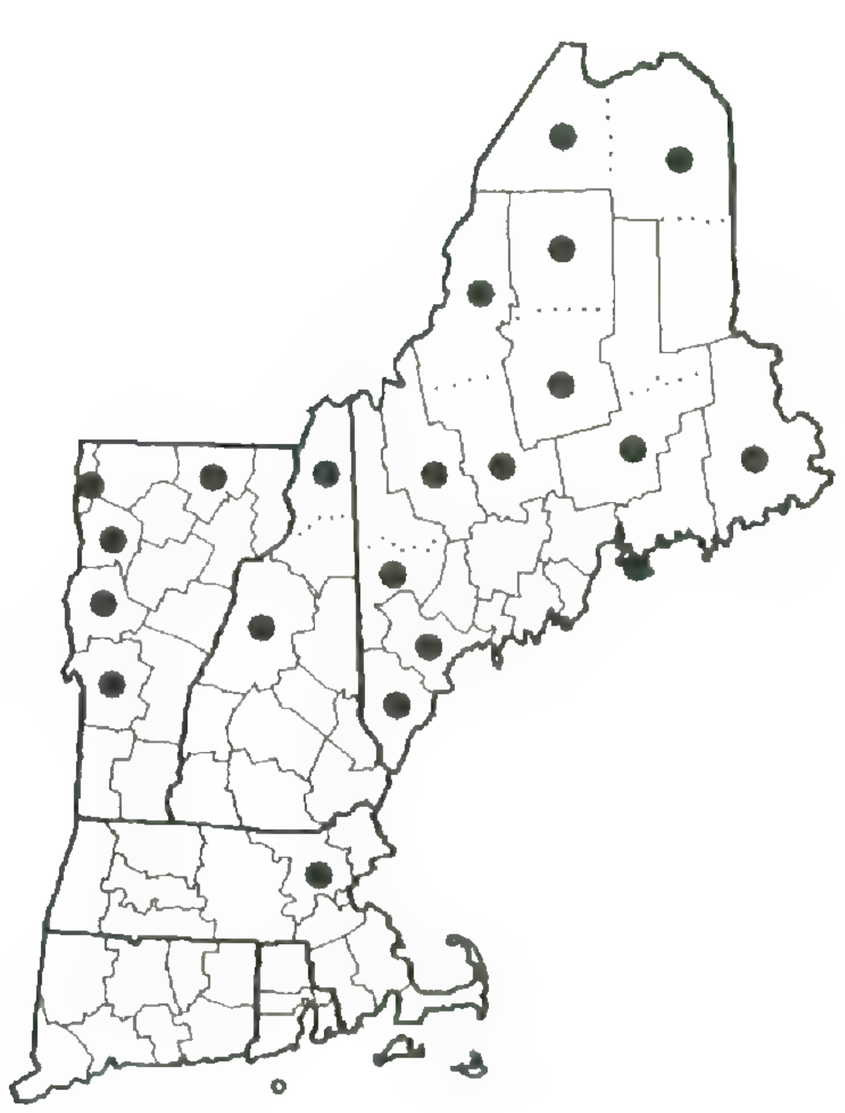
Isoëtes acadiensis



Isoëtes echinospora

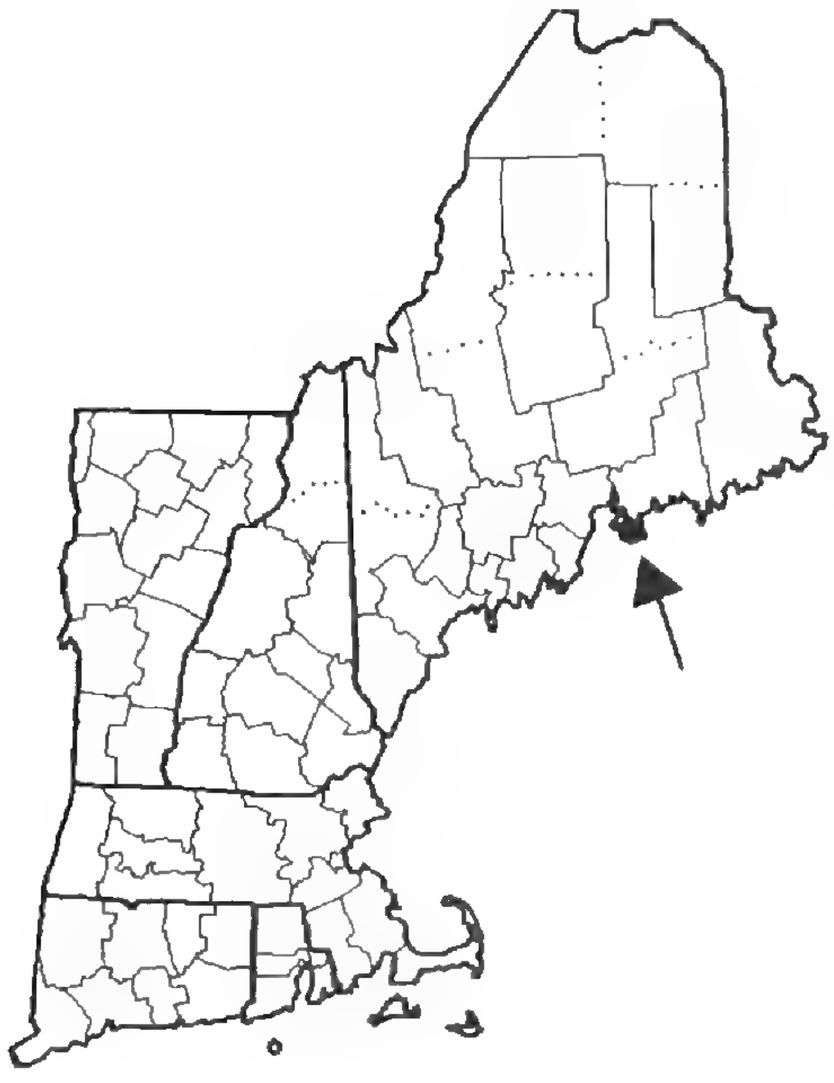


Isoëtes engelmannii

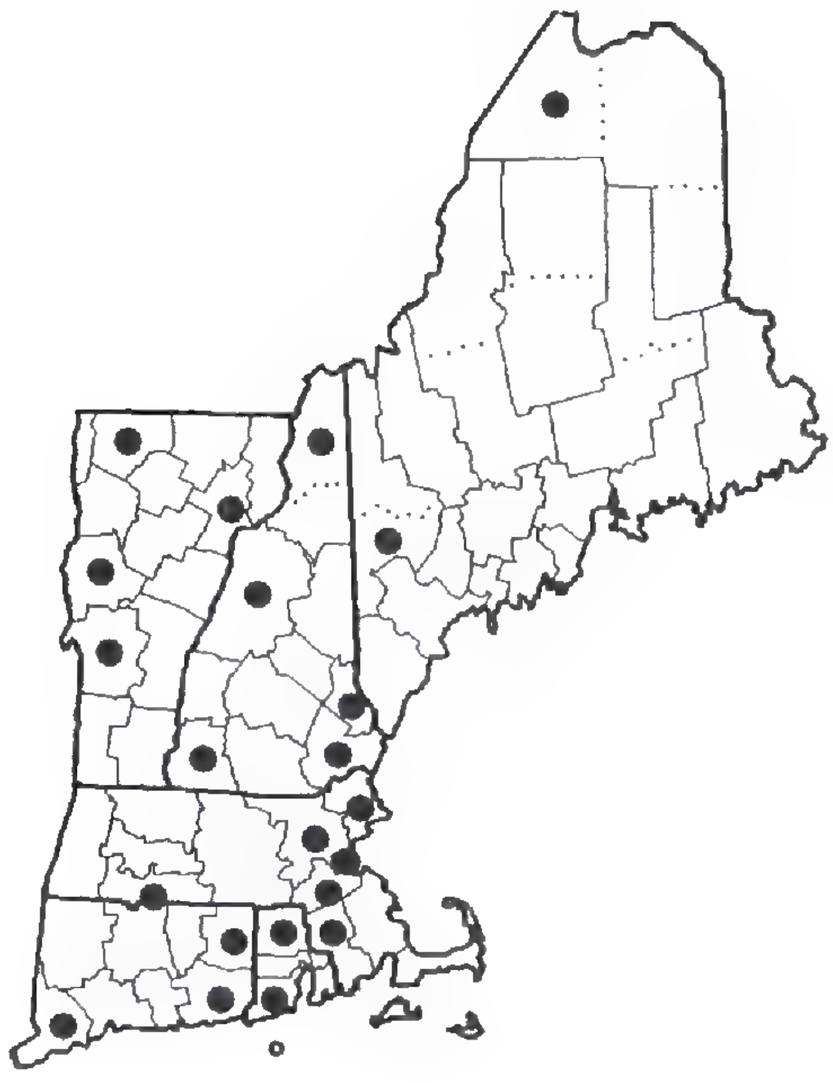


Isoëtes lacustris

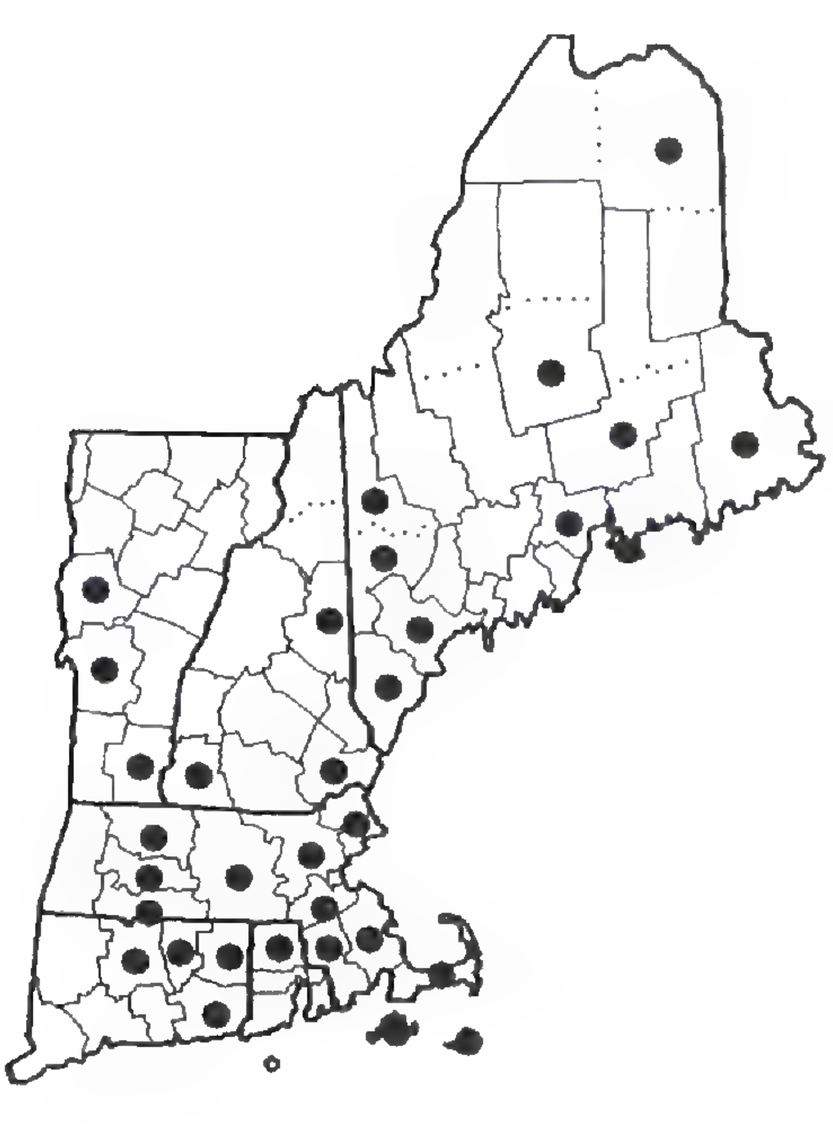
Figure 2. Distribution maps for *Isoëtes acadiensis*, *I. echinospora*, *I. engelmannii*, and *I. lacustris*.



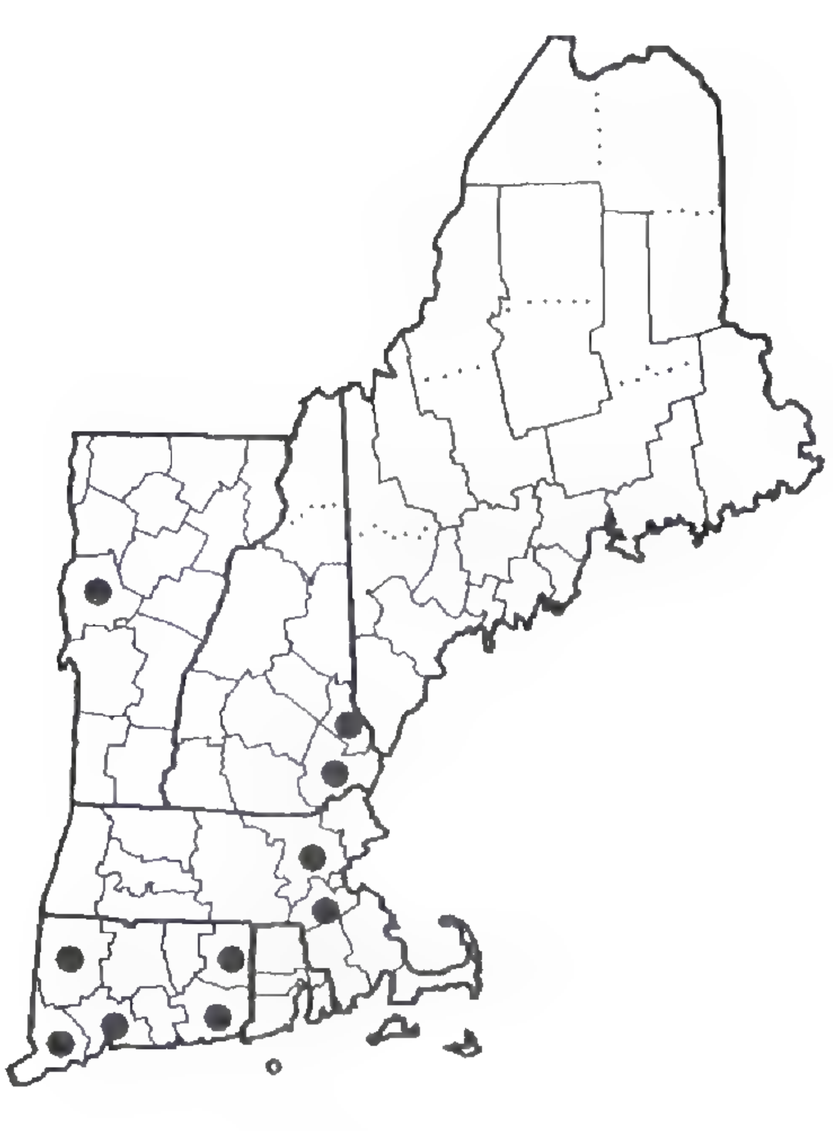
Isoëtes prototypus



Isoëtes riparia

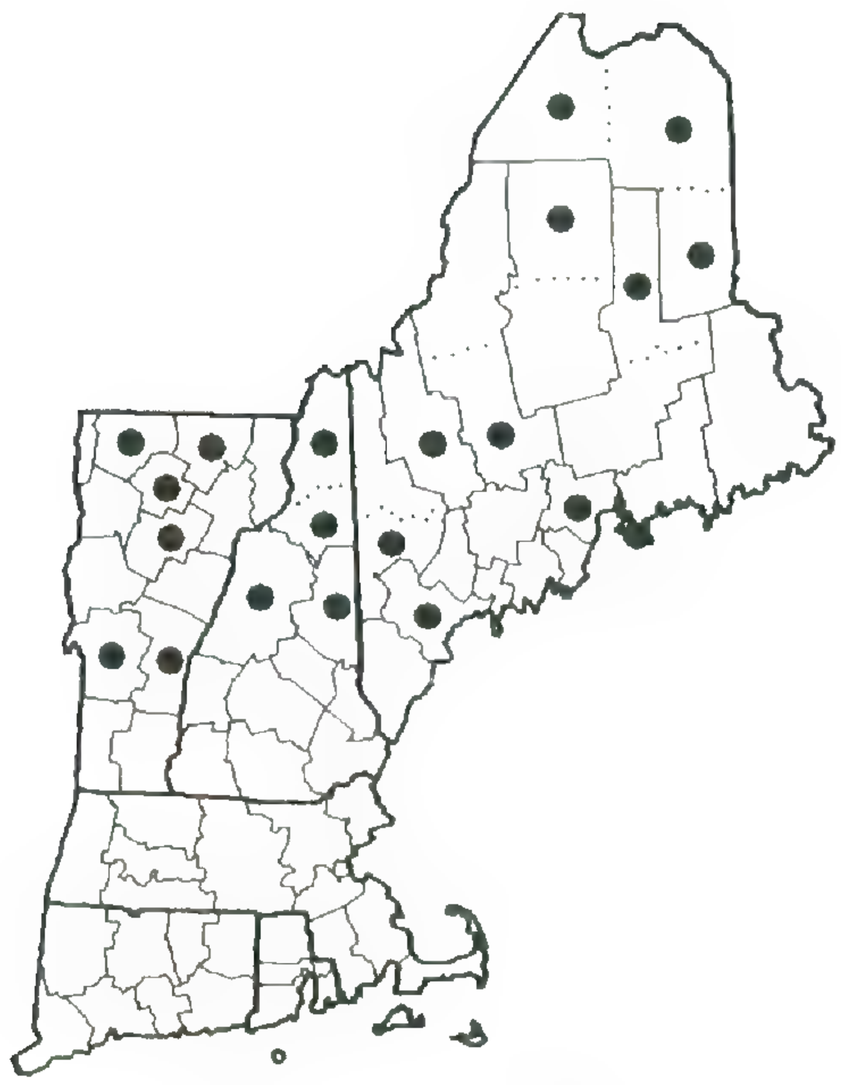


Isoëtes tuckermanii

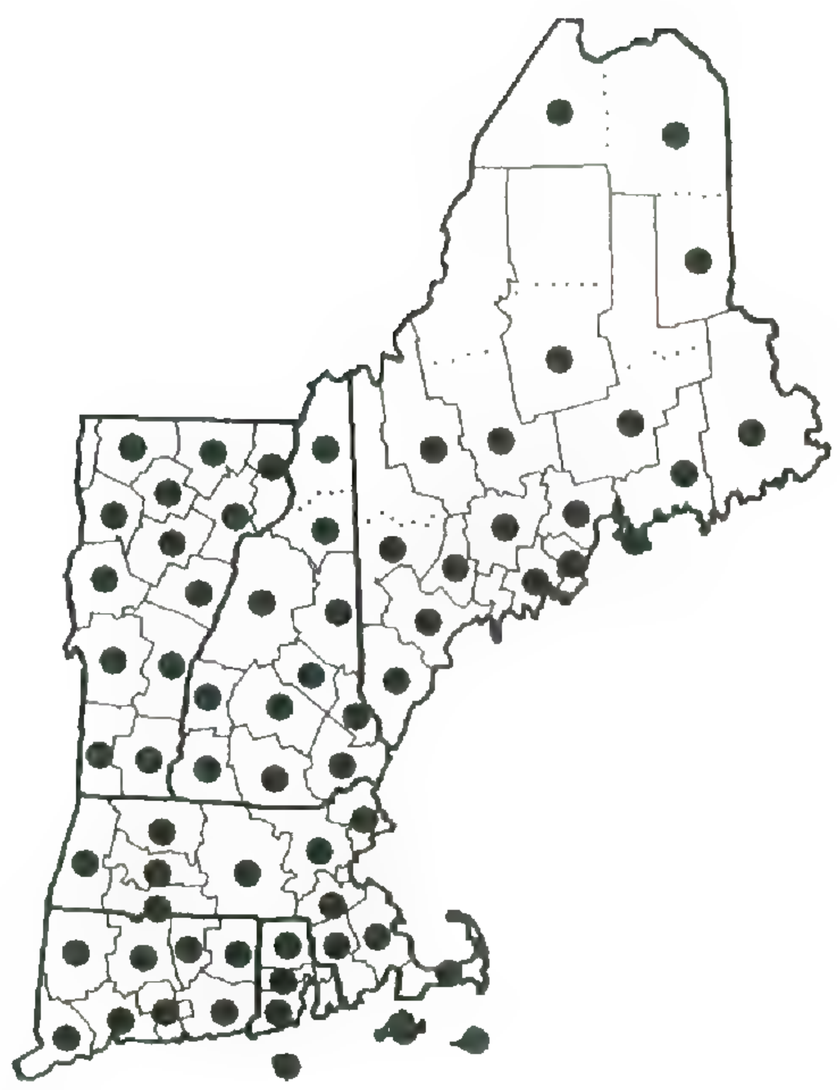


Isoëtes x eatonii

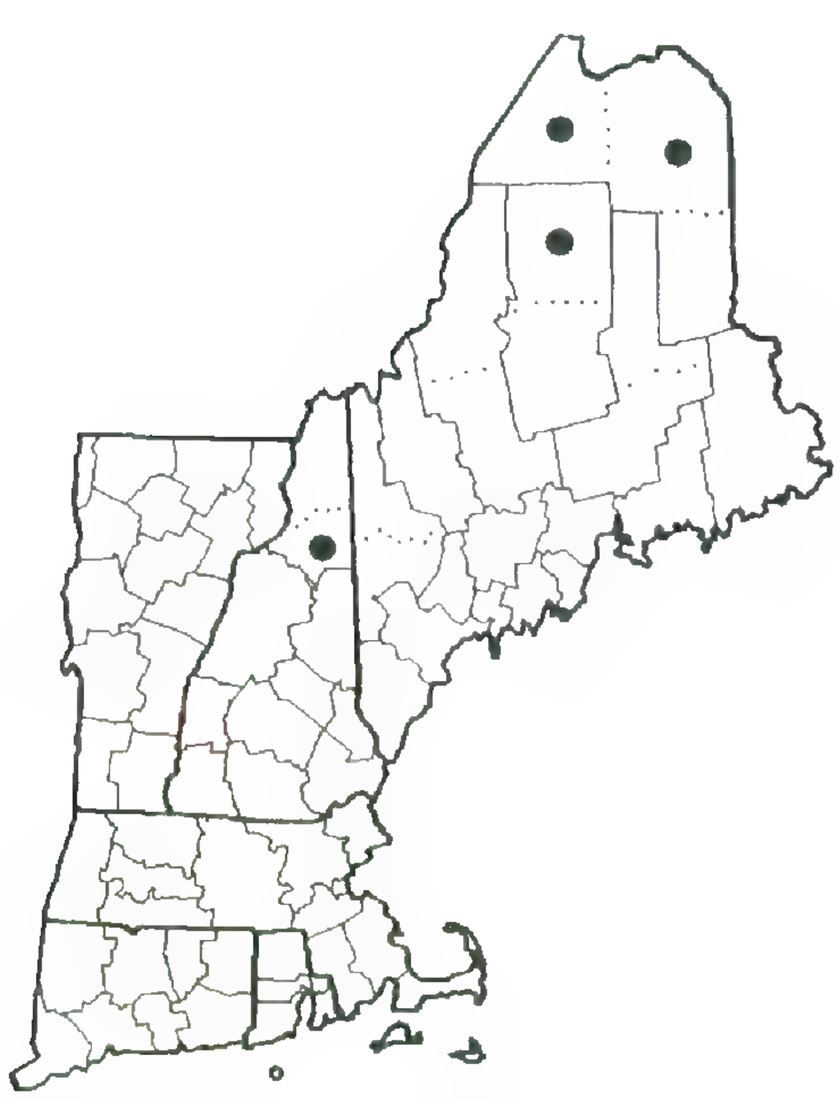
Figure 3. Distribution maps for *Isoëtes prototypus, I. riparia, I. tuckermanii*, and *I.* × *eatonii*.



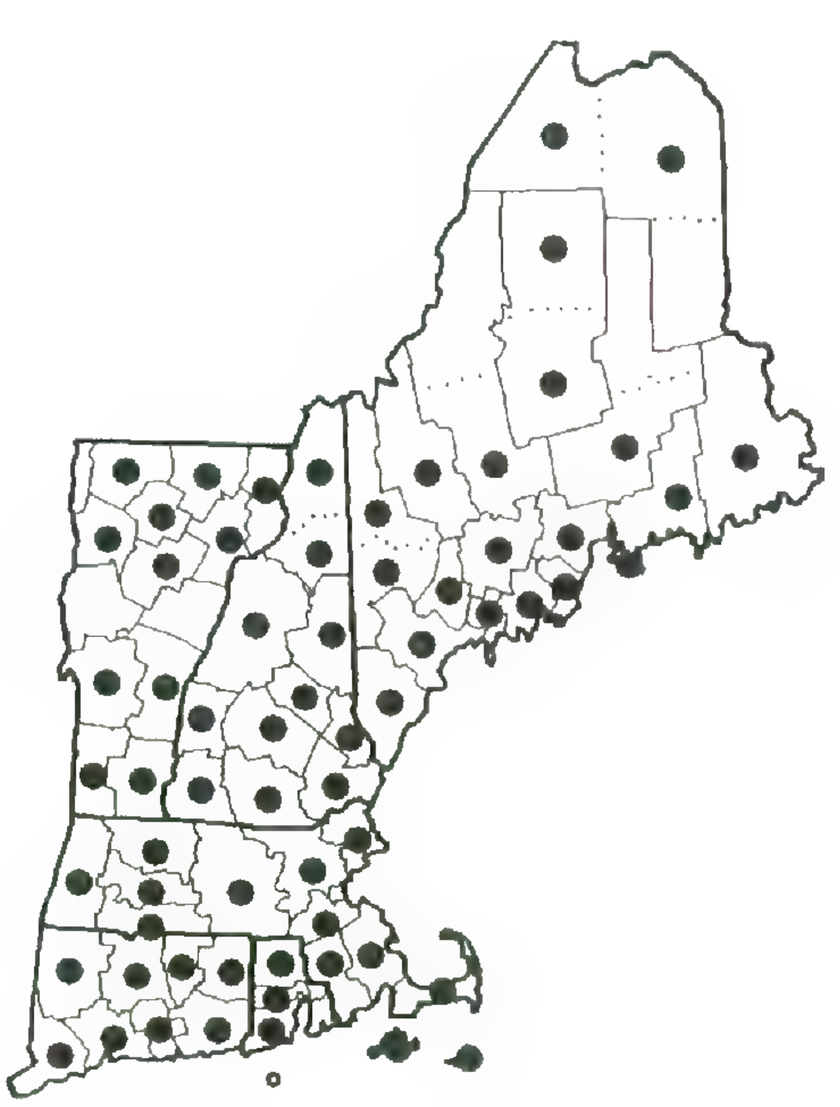
Diphasiastrum complanatum



Diphasiastrum digitatum

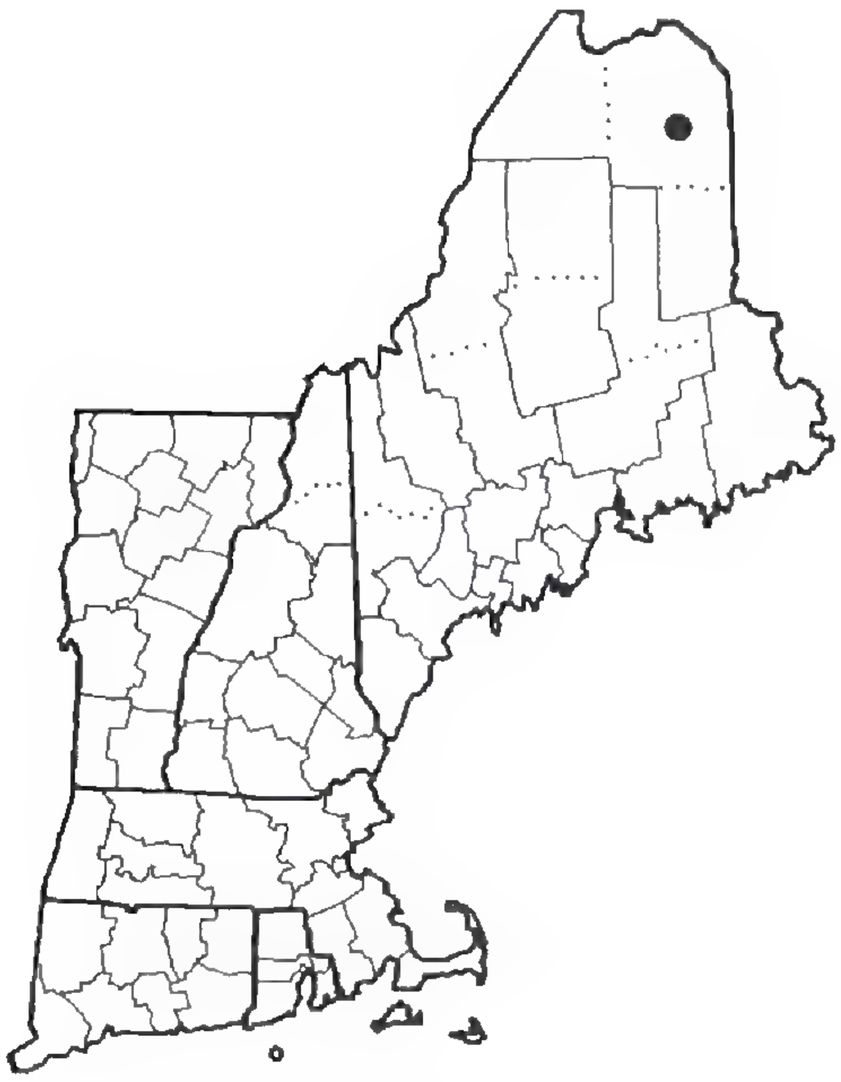


Diphasiastrum sitchense

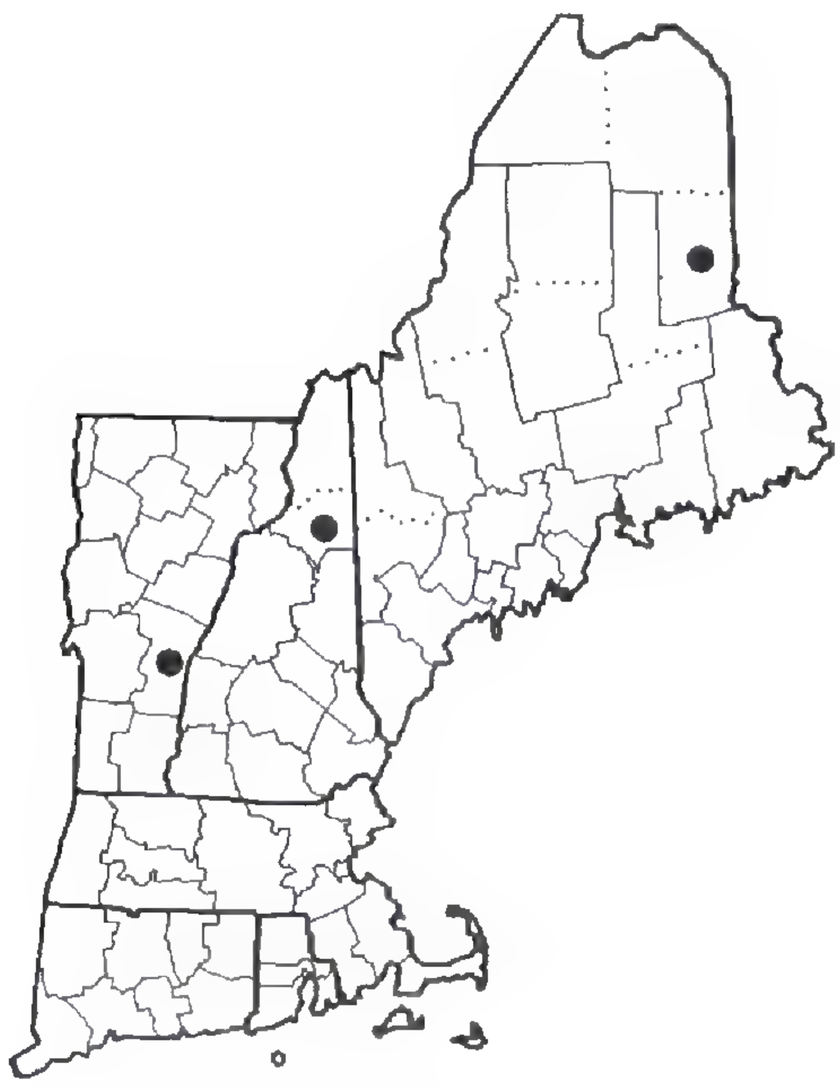


Diphasiastrum tristachyum

Figure 4. Distribution maps for *Diphasiastrum complanatum*, *D. digitatum*, *D. sitchense*, and *D. tristachyum*.

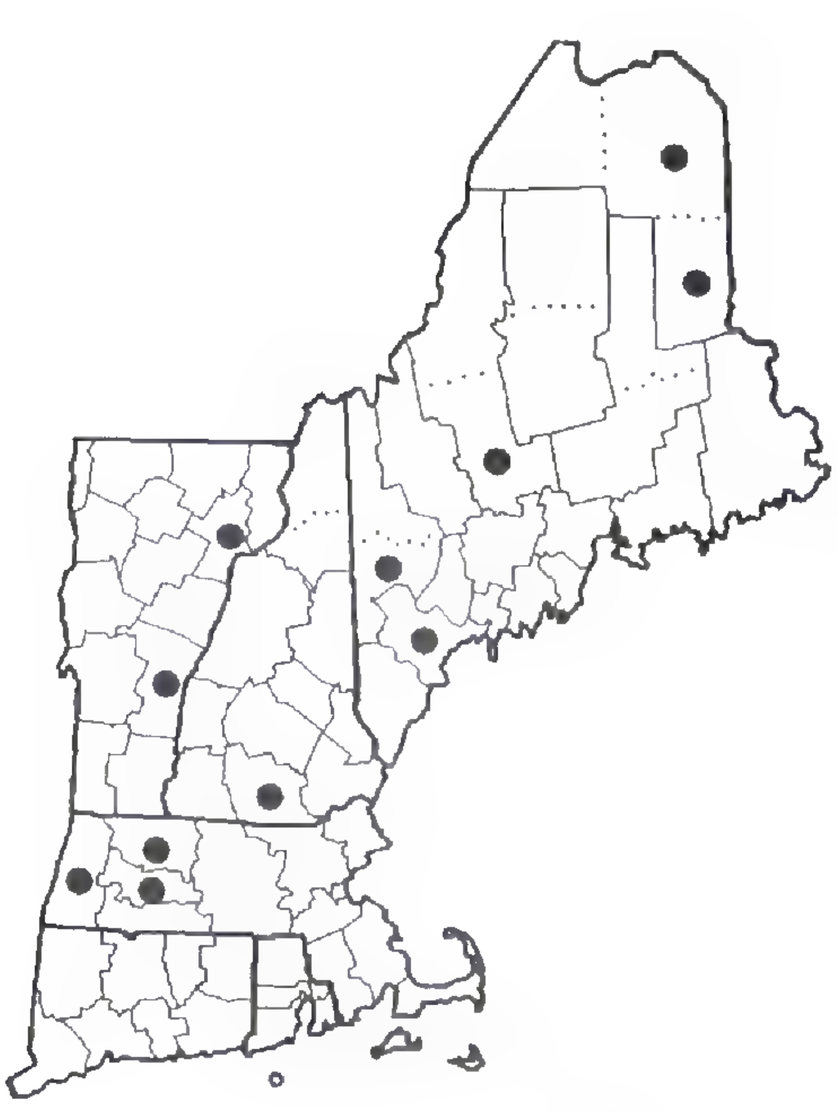


Diphasiastrum alpinum
x *D. complanatum*



Diphasiastrum complanatum
x *D. digitatum*

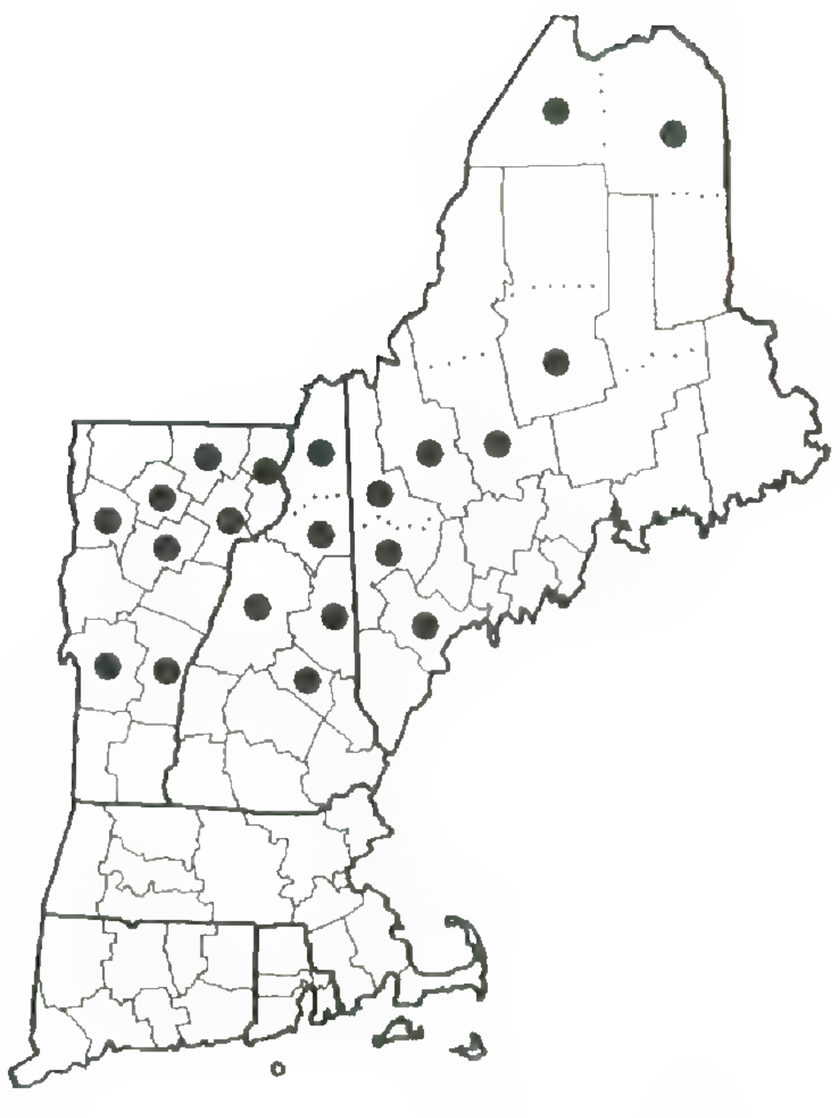
Diphasiastrum digitatum
x *D.* x *sabinifolium*



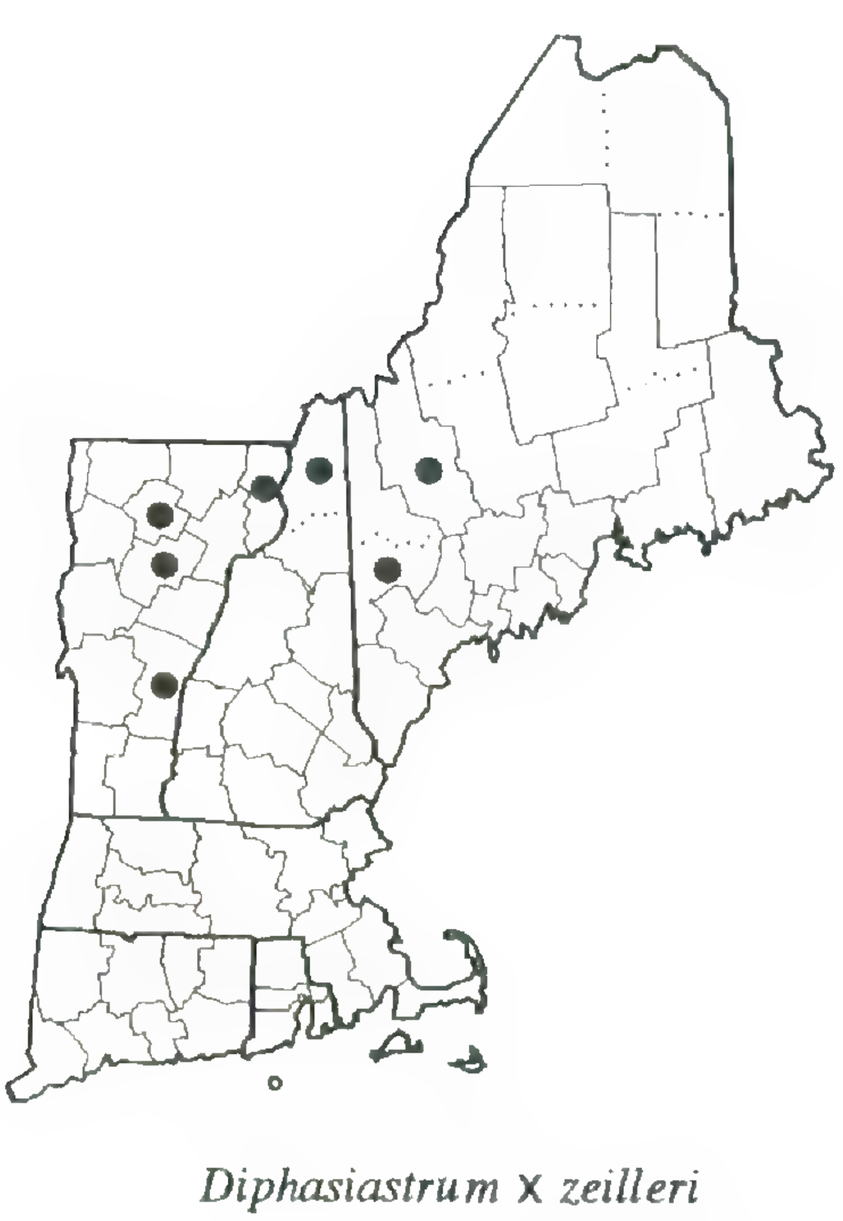
Diphasiastrum x *habereri*

Figure 5. Distribution maps for *Diphasiastrum alpinum* × *D. complanatum*, *D. complanatum* × *D. digitatum*, *D. digitatum* × *D.* × *sabinifolium*, and *D.* × *habereri*.

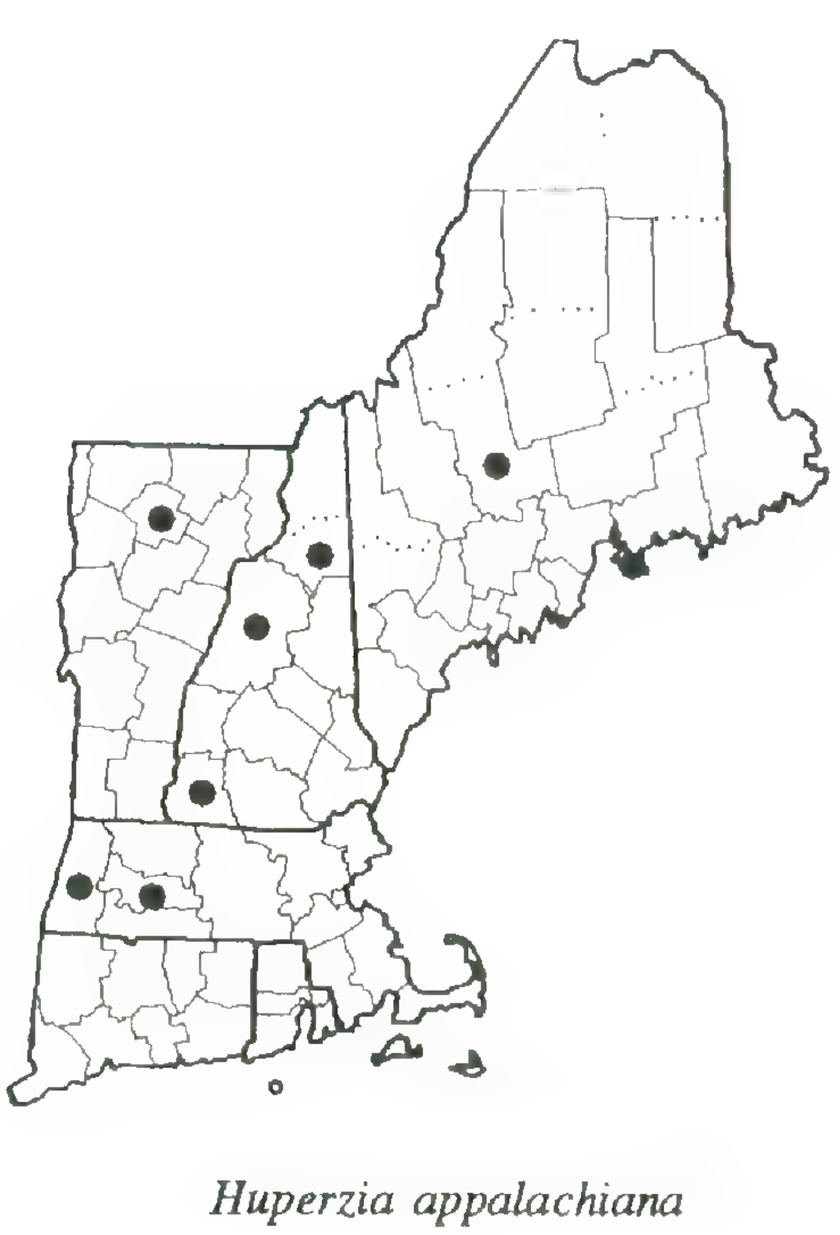
Diphasiastrum x *issleri*



Diphasiastrum x *sabinifolium*

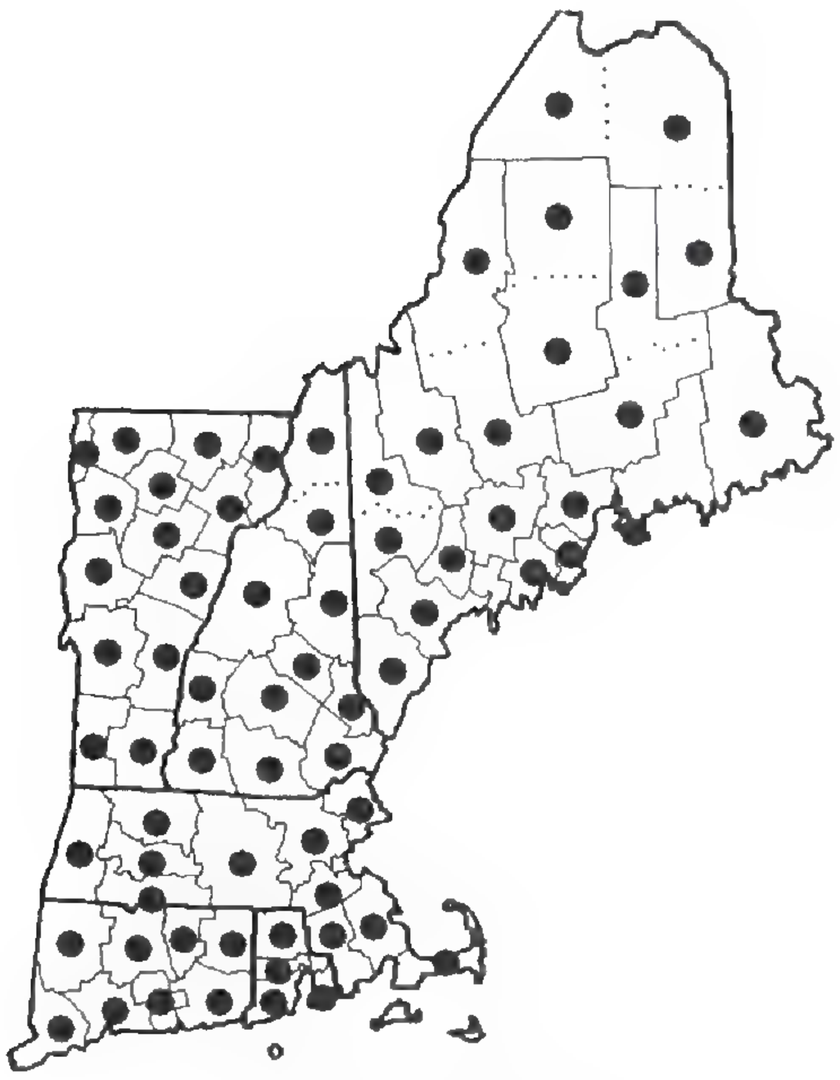


Diphasiastrum x *zeilleri*

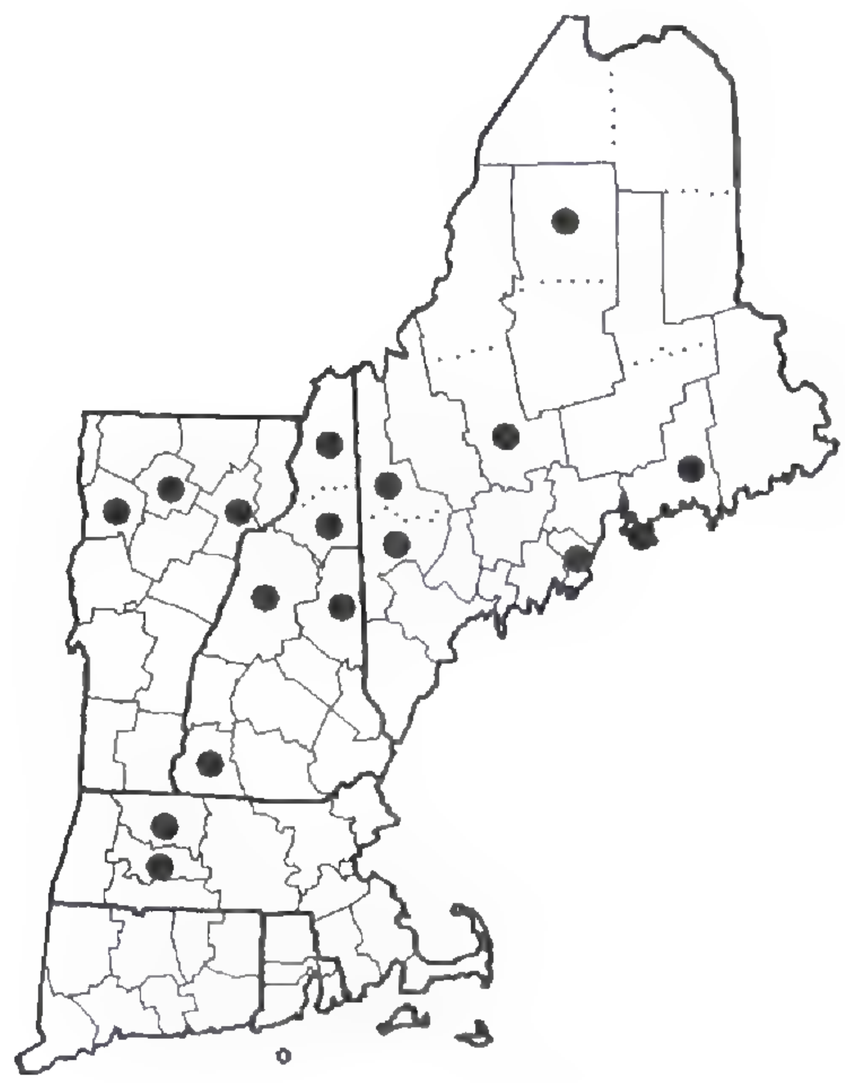


Huperzia appalachiana

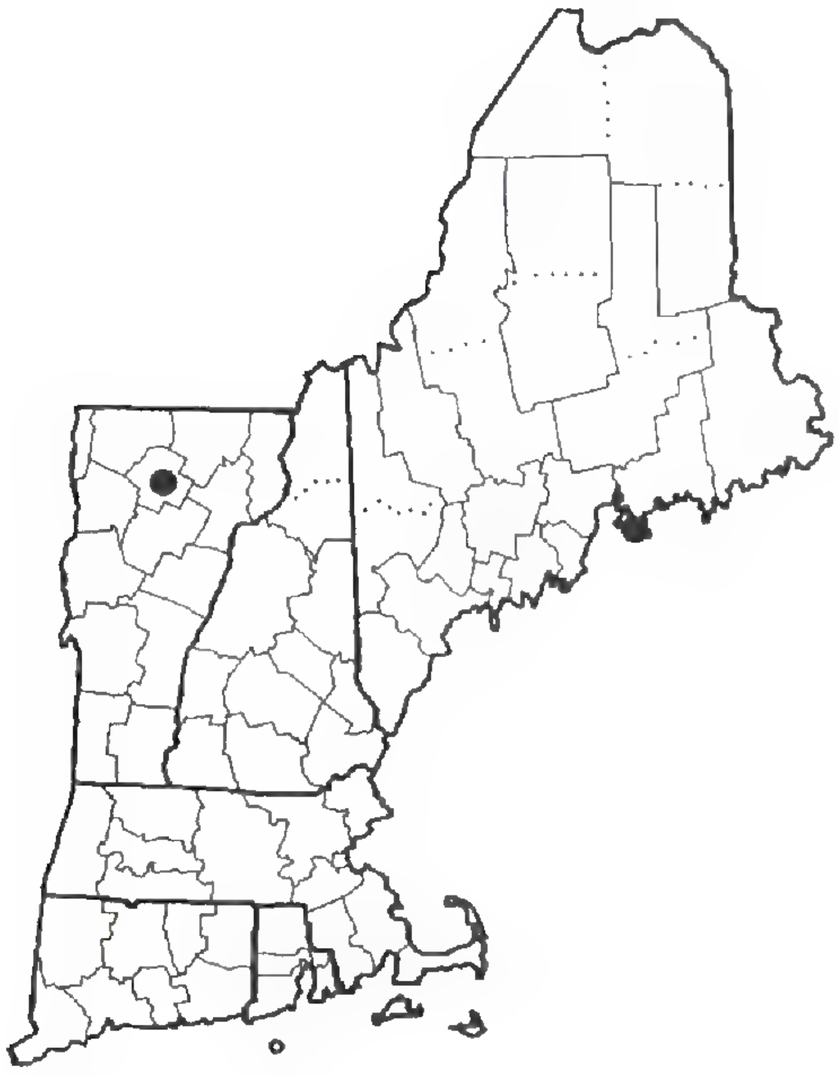
Figure 6. Distribution maps for *Diphasiastrum* × *issleri*, *D.* × *sabinifolium*, *D.* × *zeilleri*, and *Huperzia appalachiana*.



Huperzia lucidula



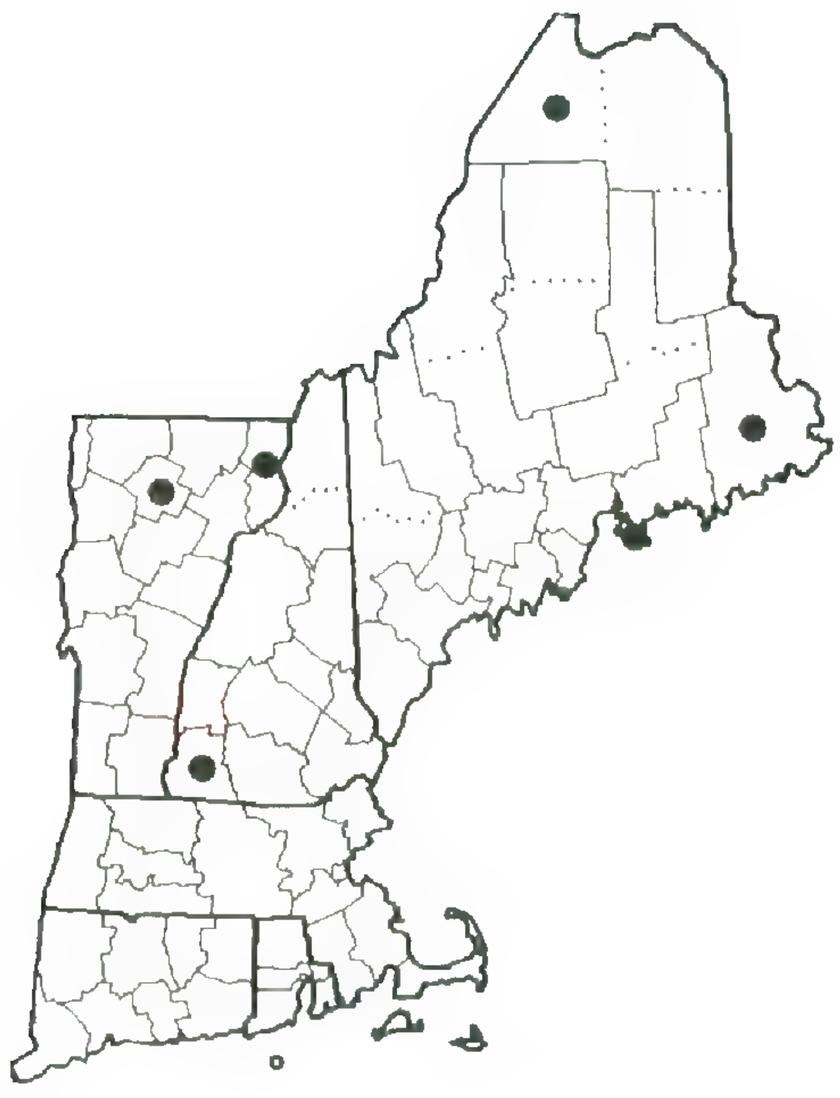
Huperzia selago



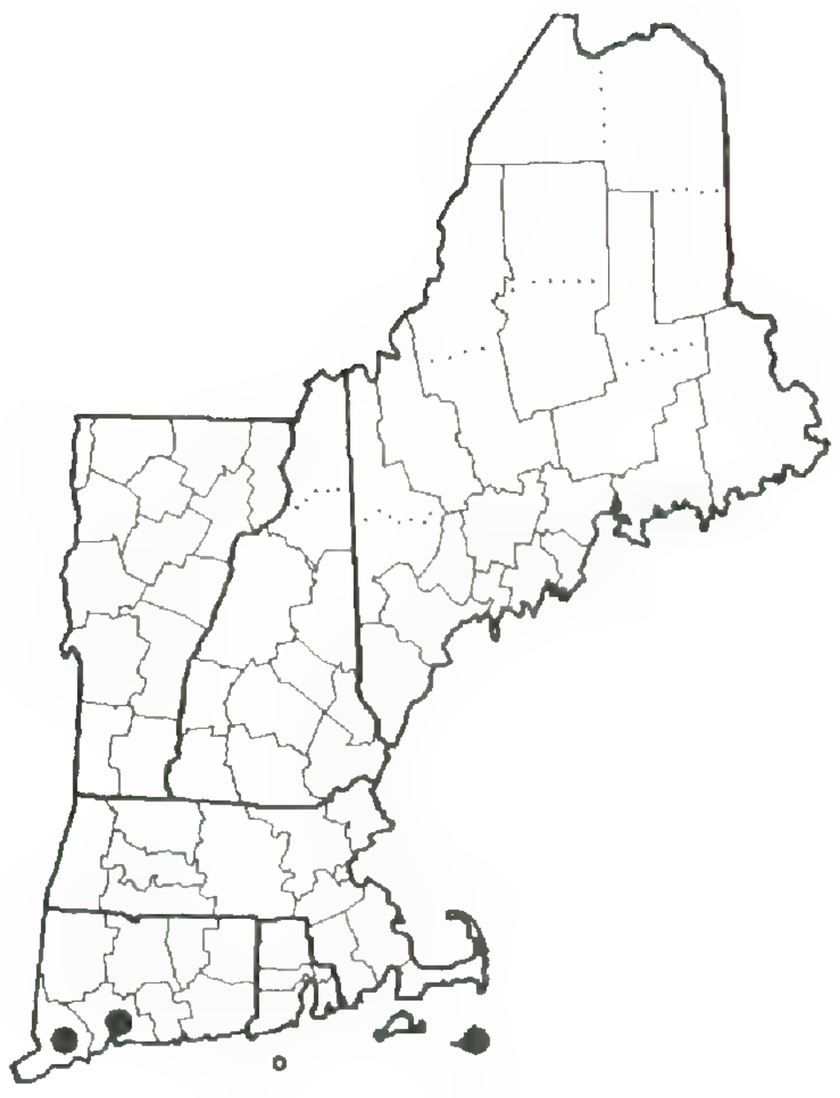
Huperzia appalachiana x *lucidula*

Huperzia appalachiana x *selago*

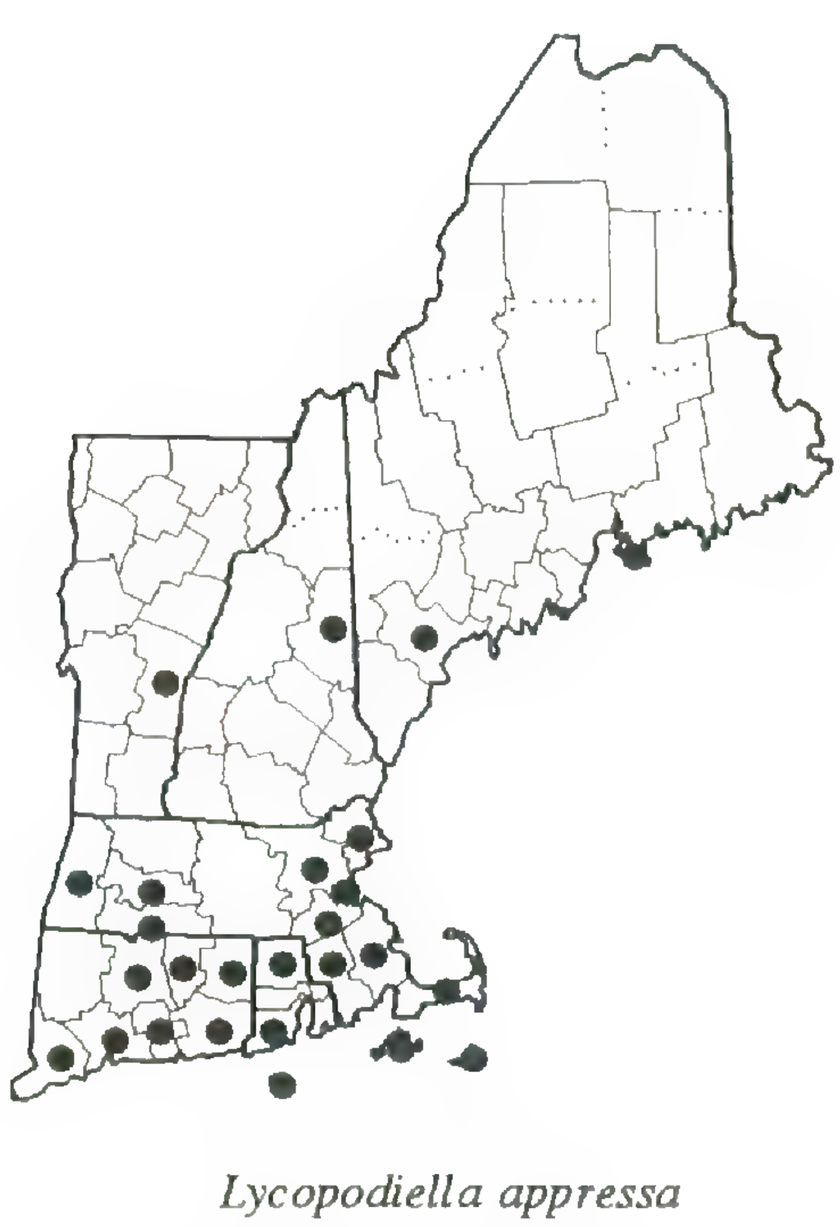
Figure 7. Distribution maps for *Huperzia lucidula, H. selago, H. appalachiana* × *H. lucidula*, and *H. appalachiana* × *H. selago*.



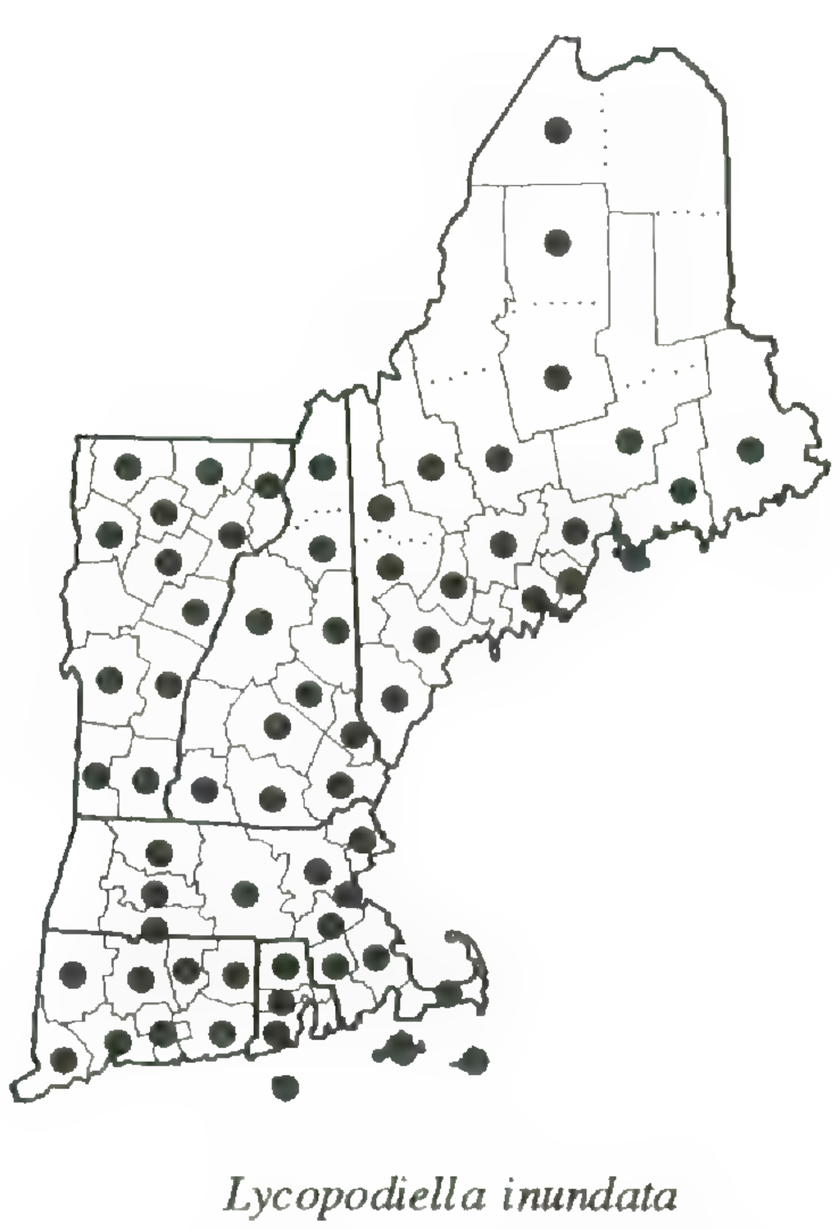
Huperzia x buttersii



Lycopodiella alopecuroides

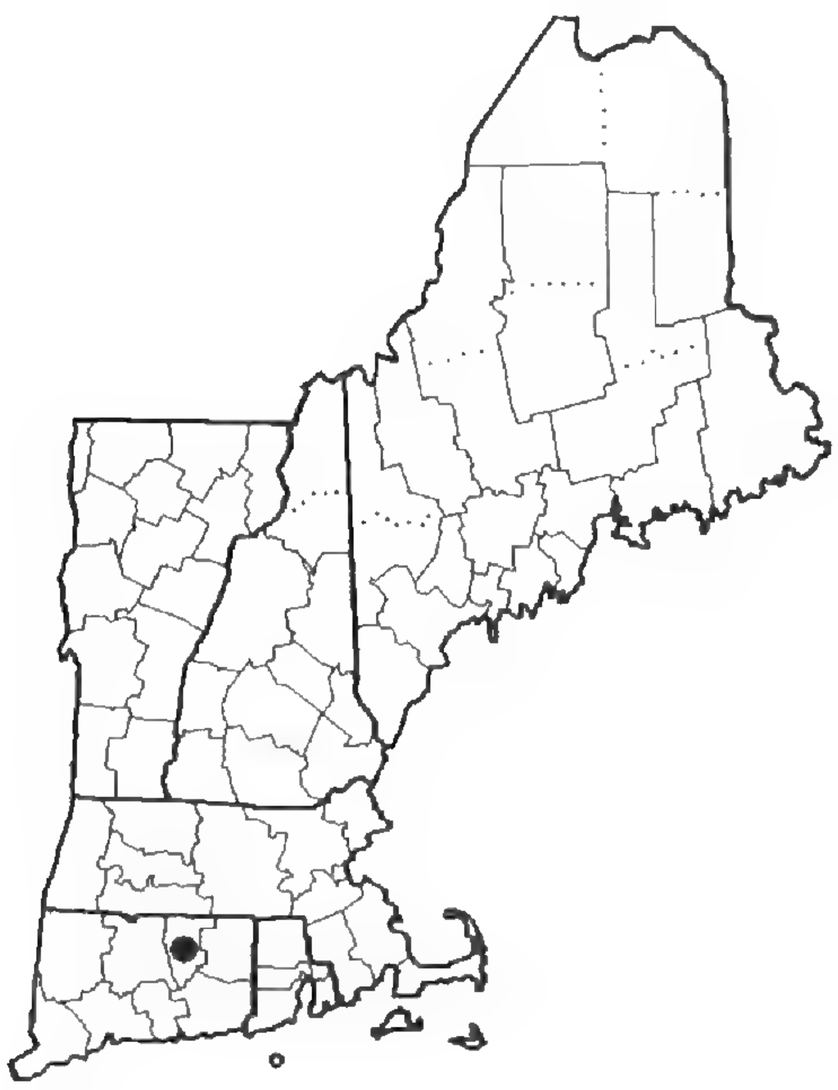


Lycopodiella appressa

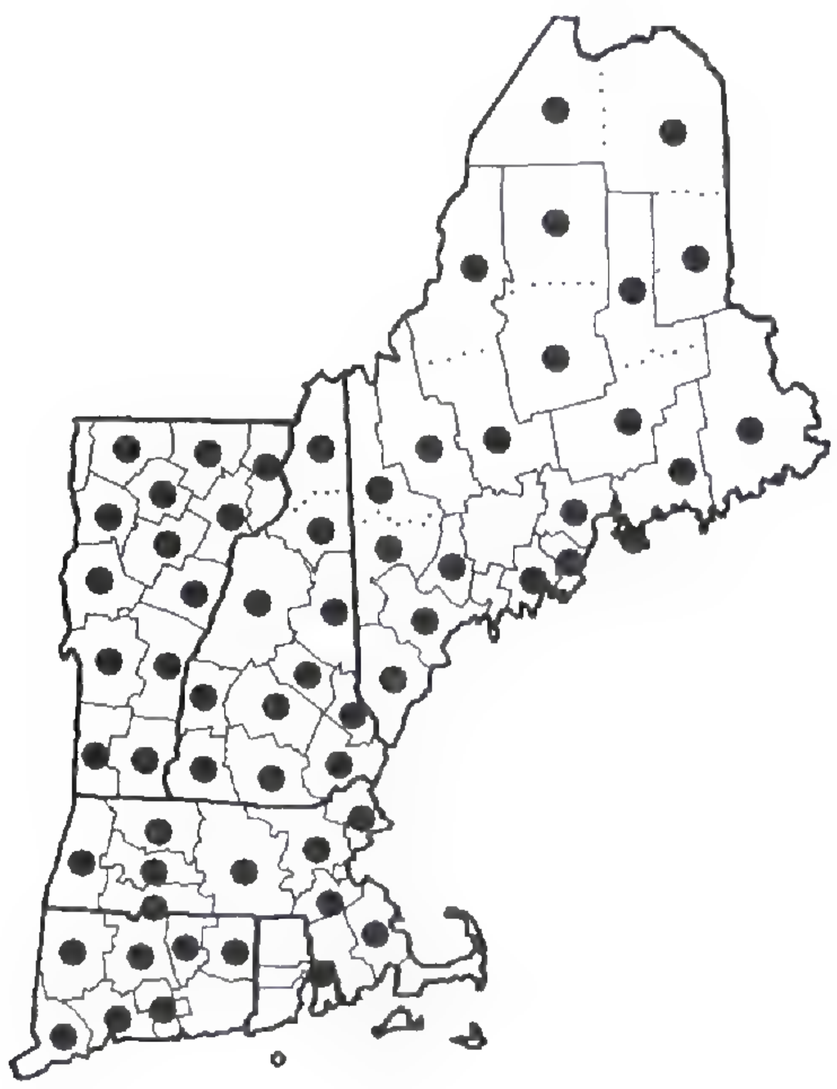


Lycopodiella inundata

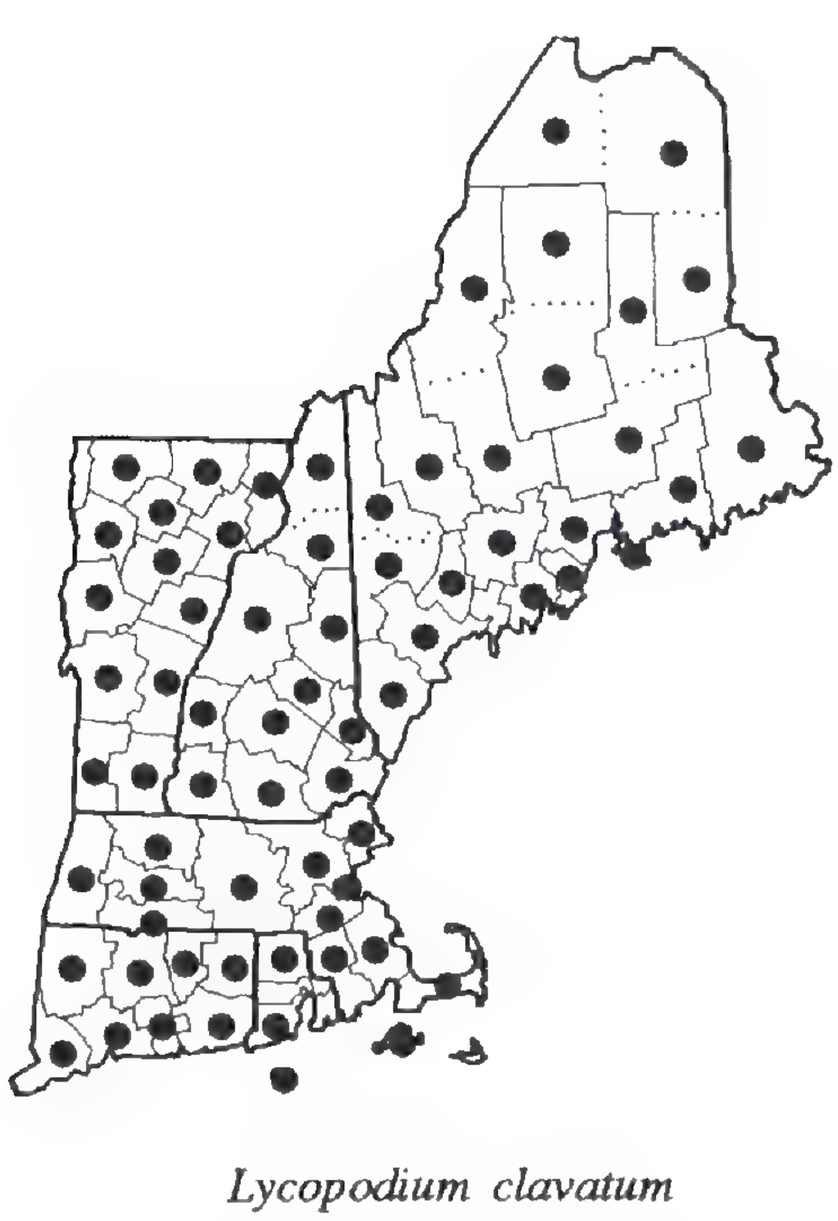
Figure 8. Distribution maps for *Huperzia* × *buttersii*, *Lycopodiella alopecuroides*, *L. appressa*, and *L. inundata*.



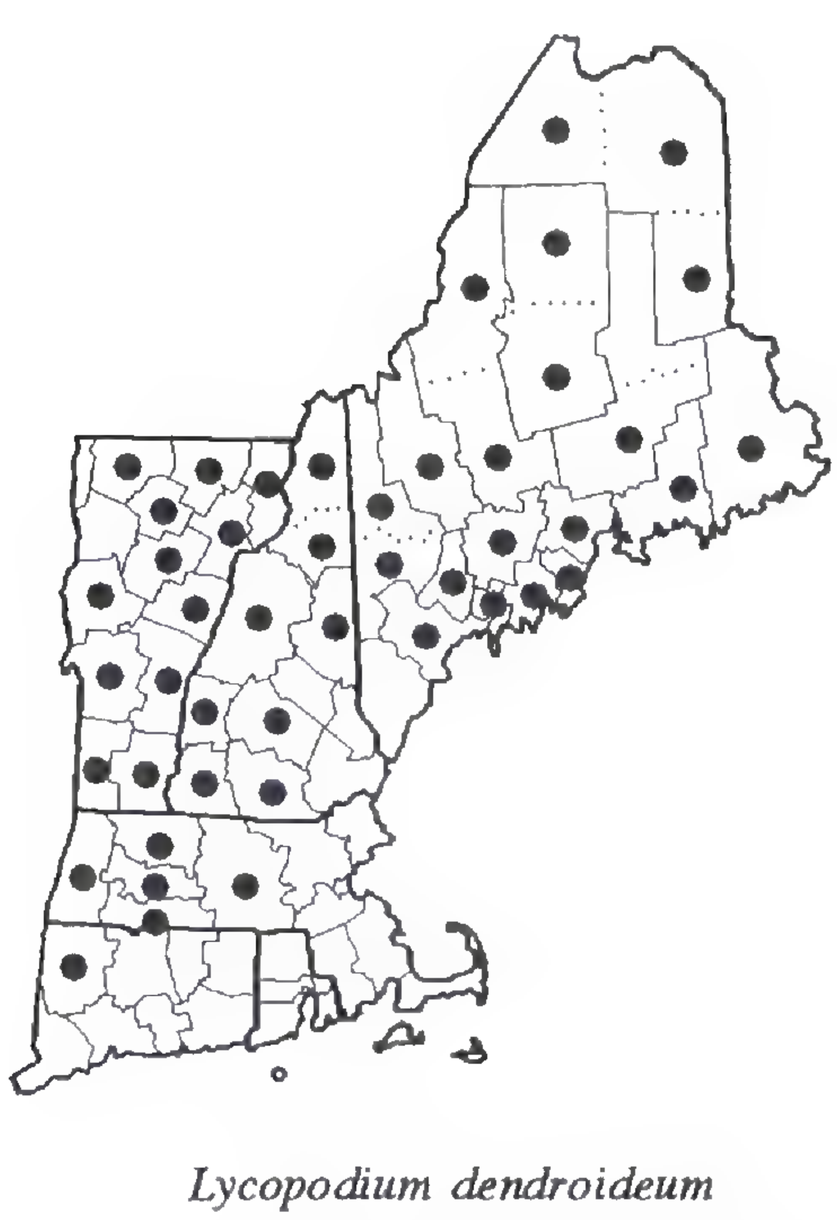
Lycopodiella margueritae



Lycopodium annotinum

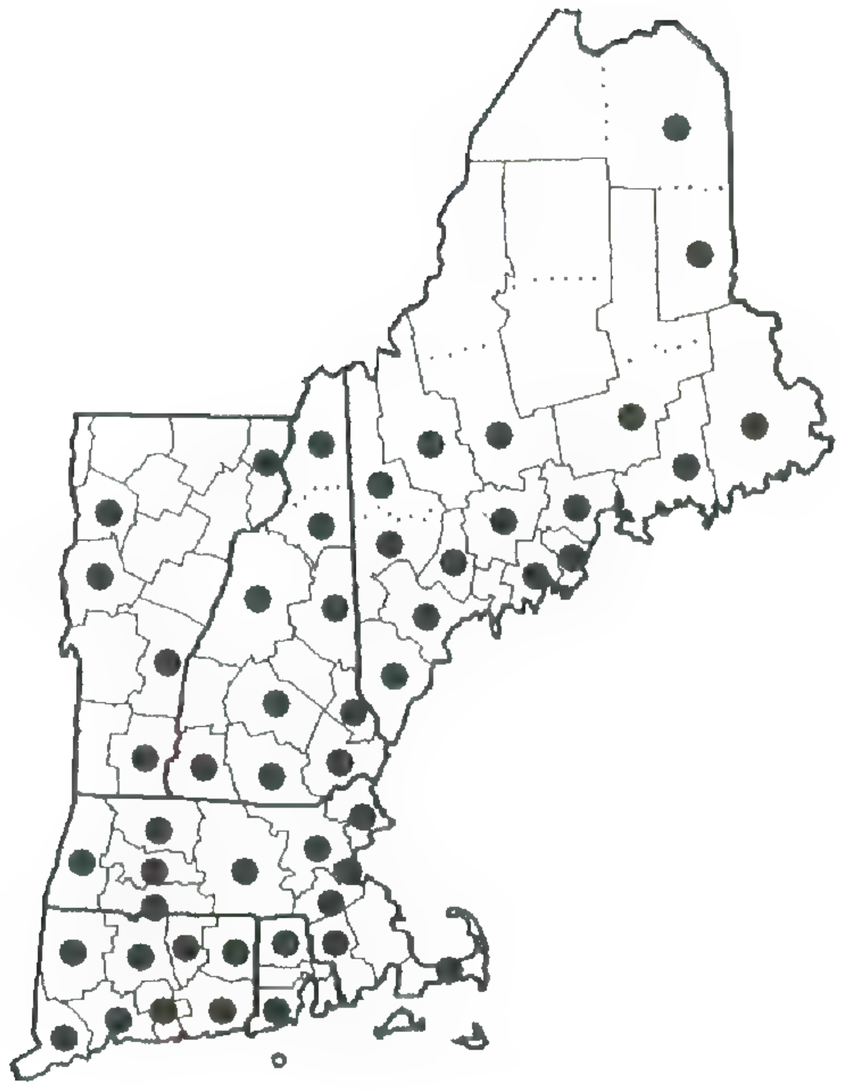


Lycopodium clavatum

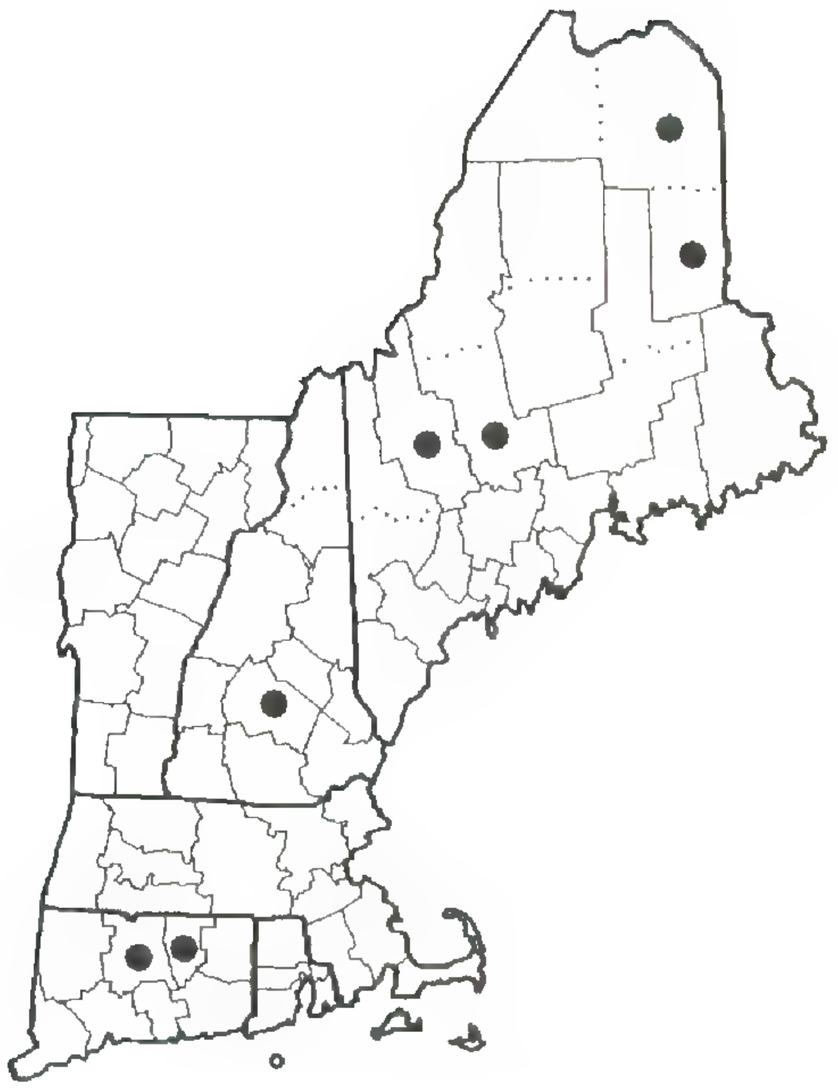


Lycopodium dendroideum

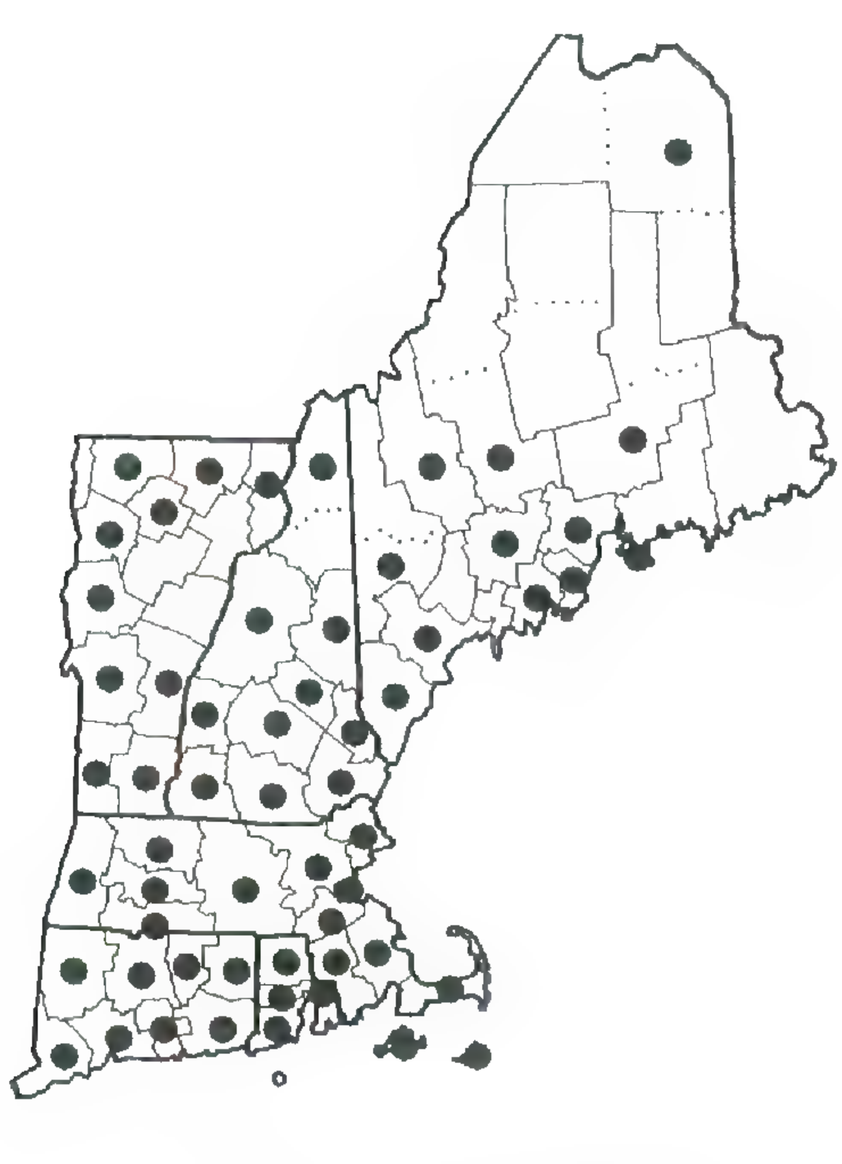
Figure 9. Distribution maps for *Lycopodiella margueritae*, *Lycopodium annotinum*, *L. clavatum*, and *L. dendroideum*.



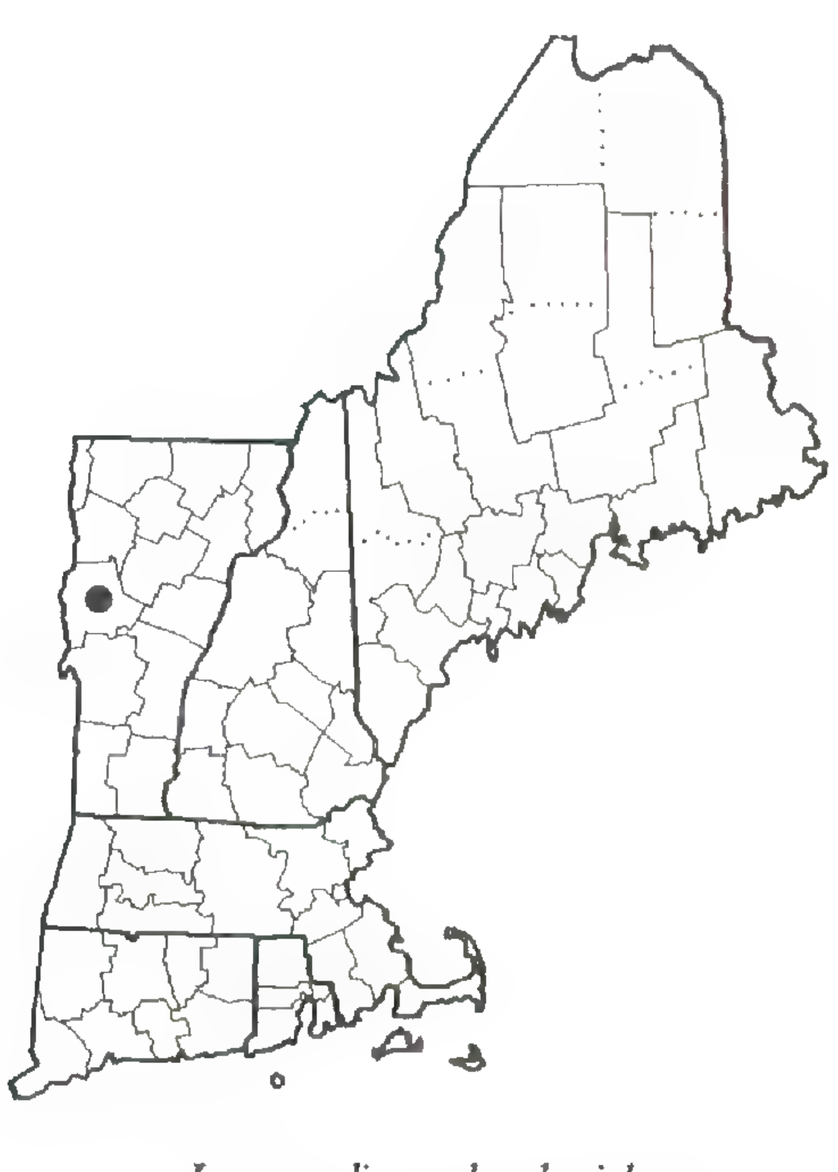
Lycopodium hickeyi



Lycopodium lagopus

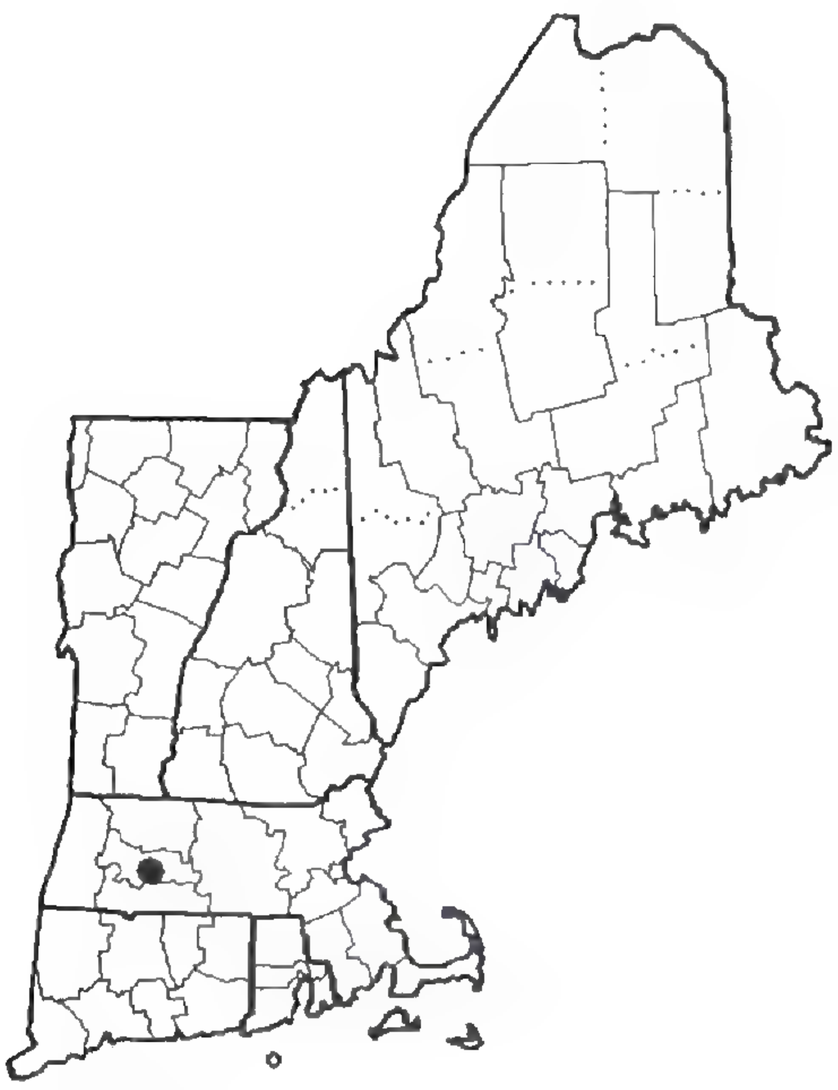


Lycopodium obscurum

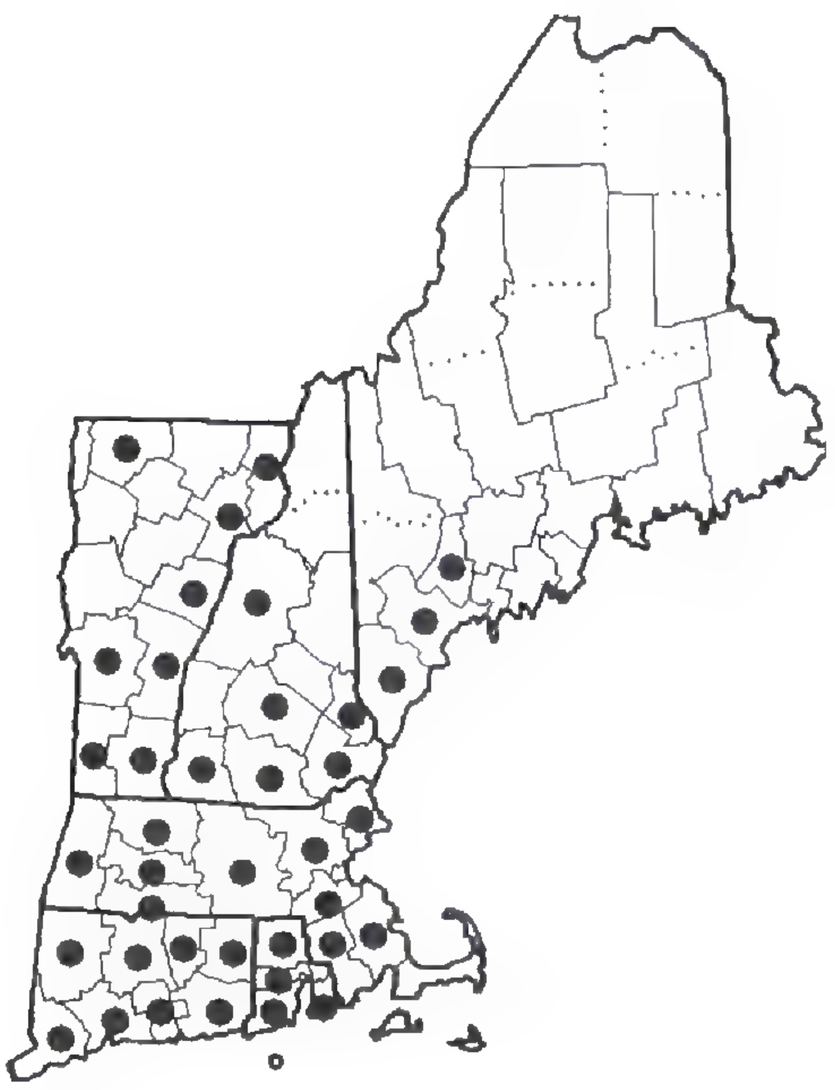


Lycopodium dendroideum x *obscurum*

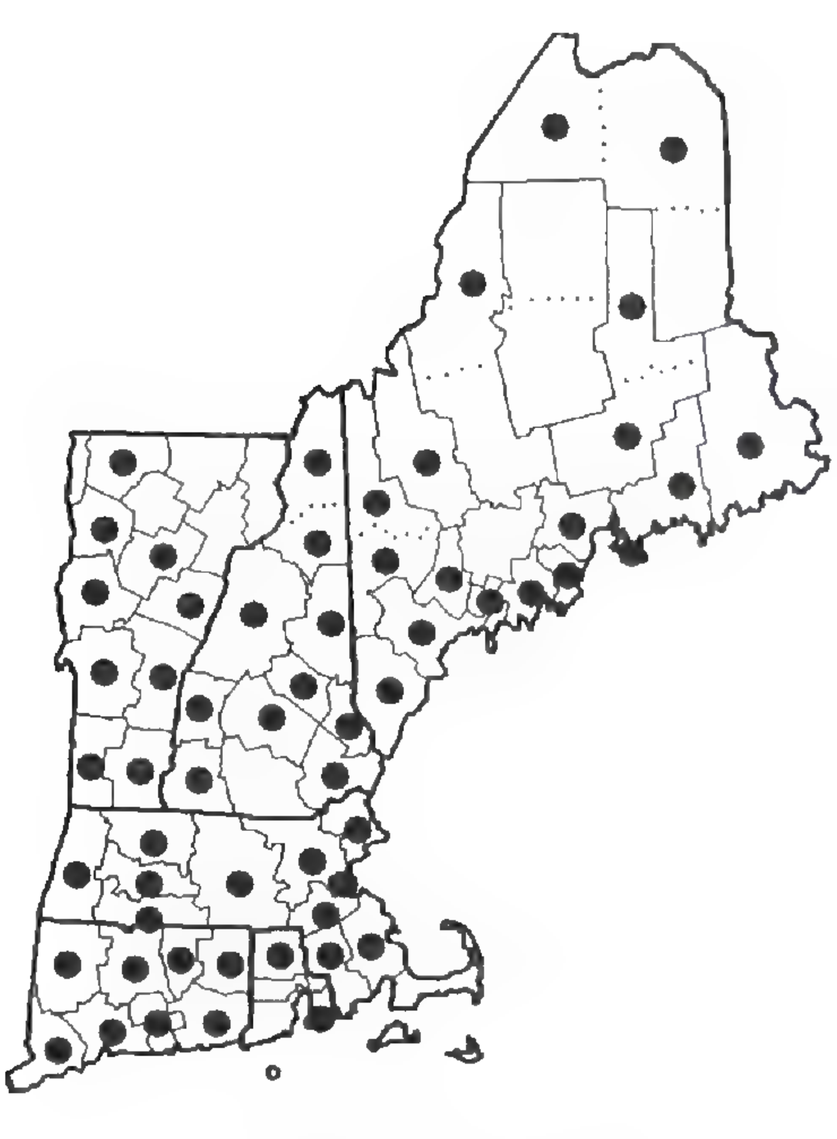
Figure 10. Distribution maps for *Lycopodium hickeyi*, *L. lagopus*, *L. obscurum*, and *L. dendroideum* × *L. obscurum*.



Pseudolycopodiella caroliniana



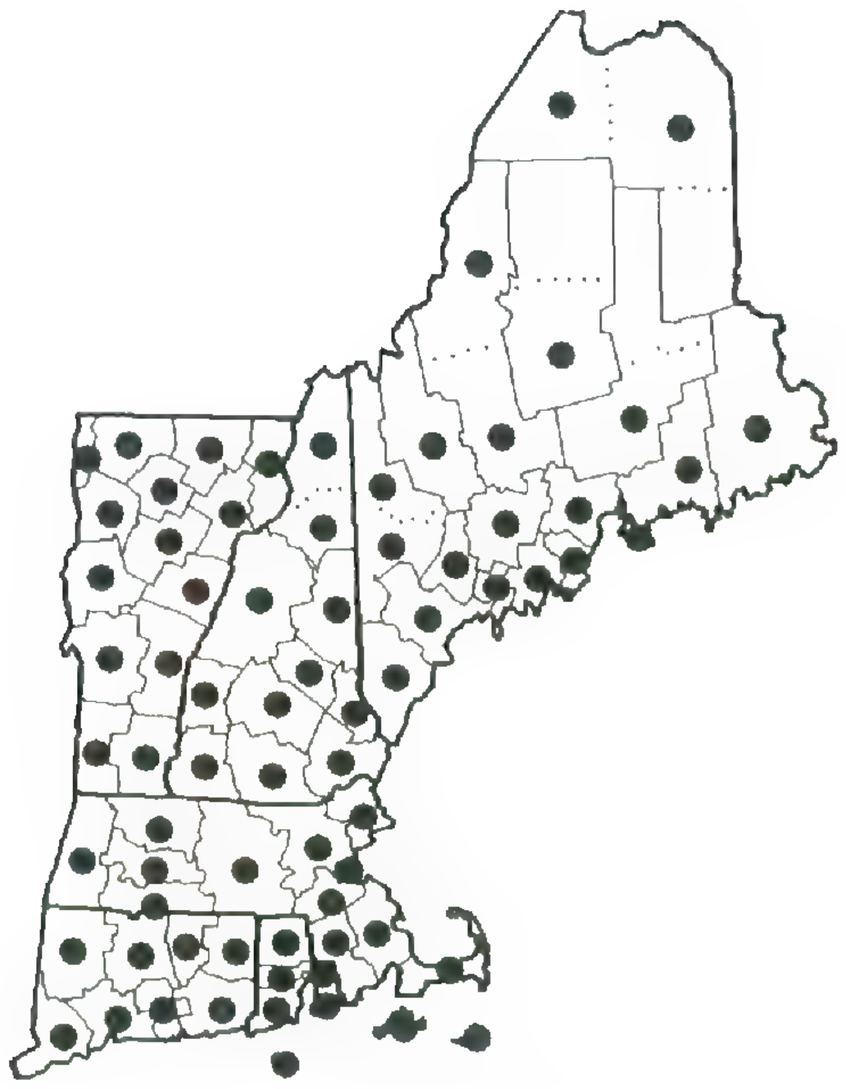
Selaginella apoda



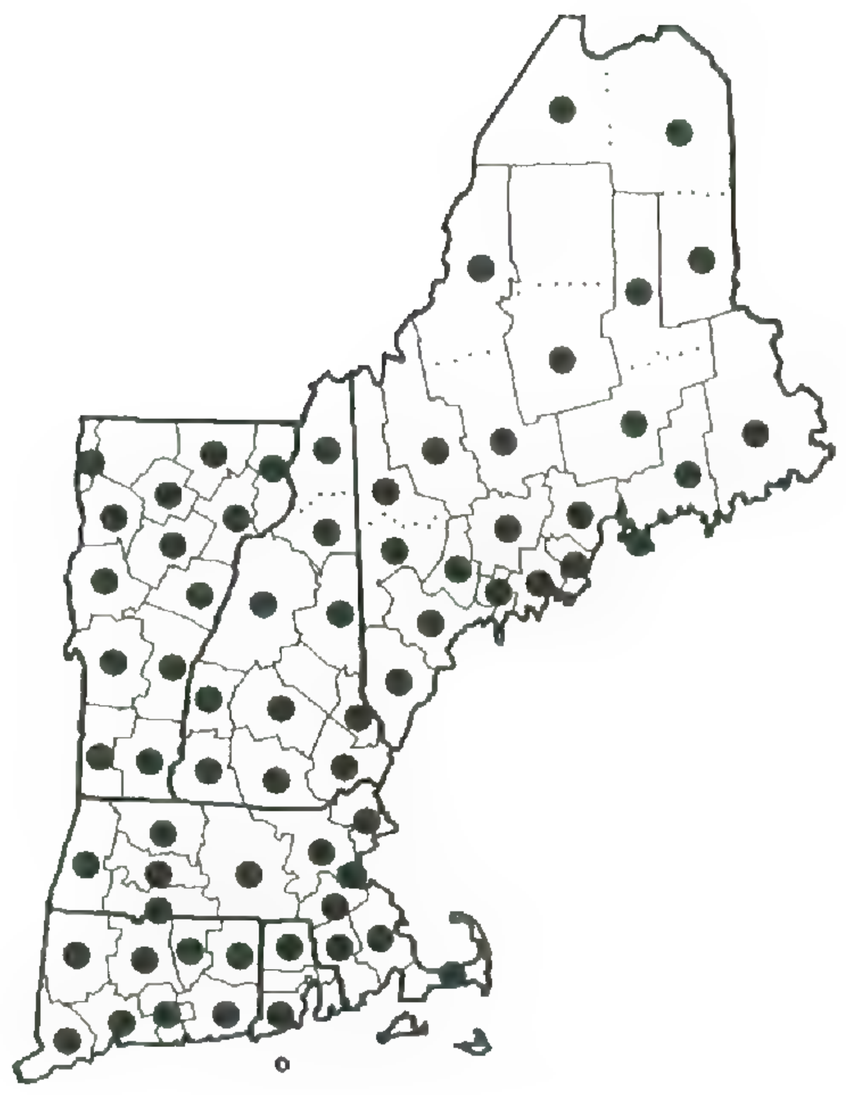
Selaginella rupestris

Selaginella selaginoides

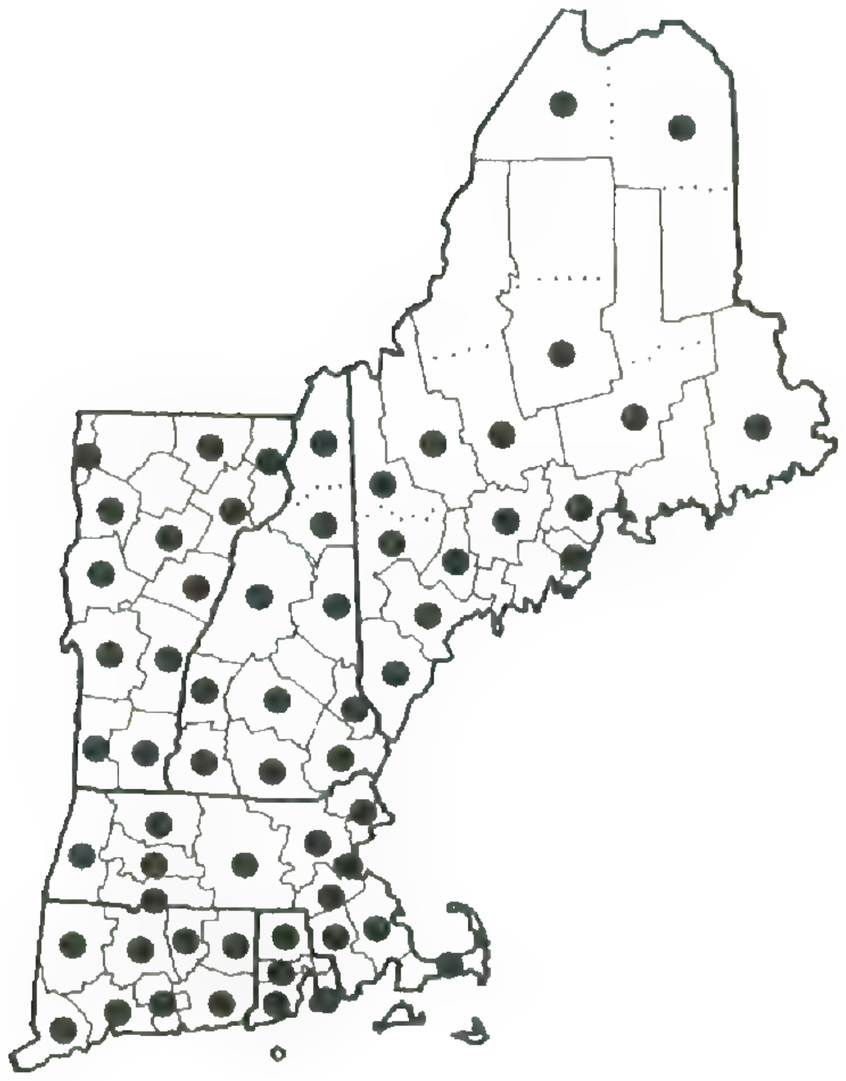
Figure 11. Distribution maps for *Pseudolycopodiella caroliniana*, *Selaginella apoda*, *S. rupestris*, and *S. selaginoides*.



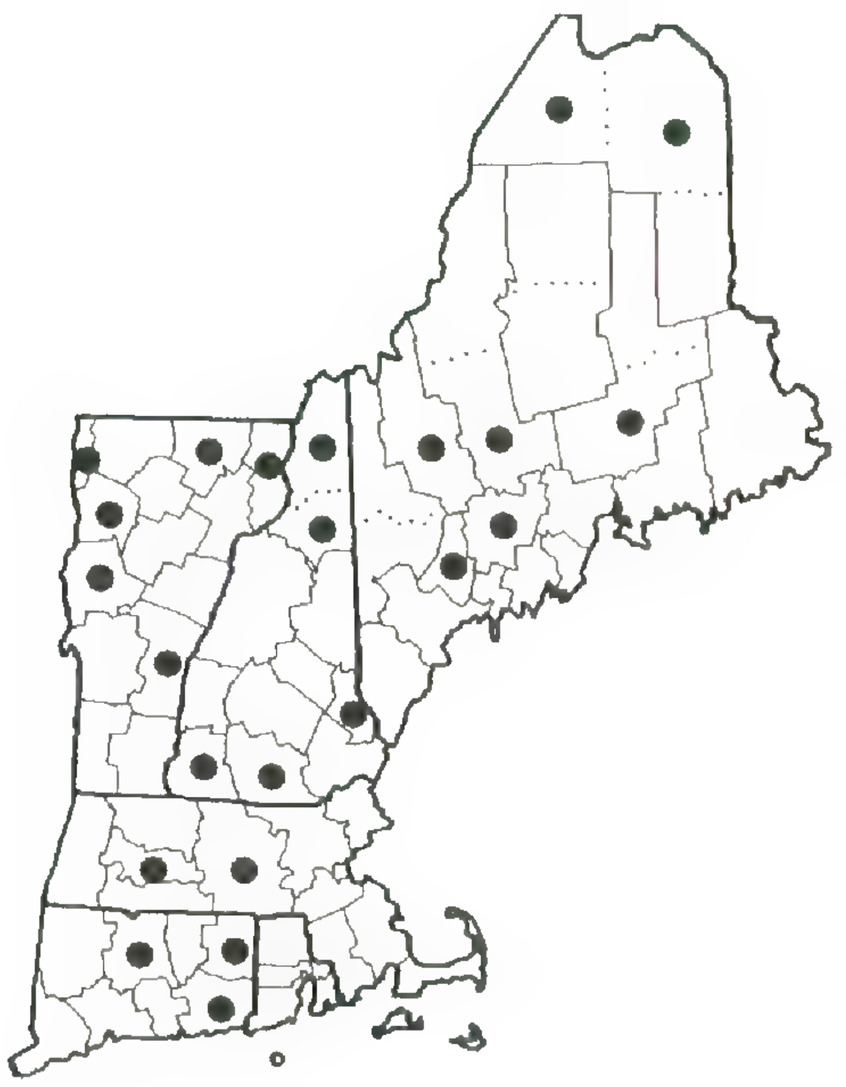
Equisetum arvense



Equisetum fluviatile

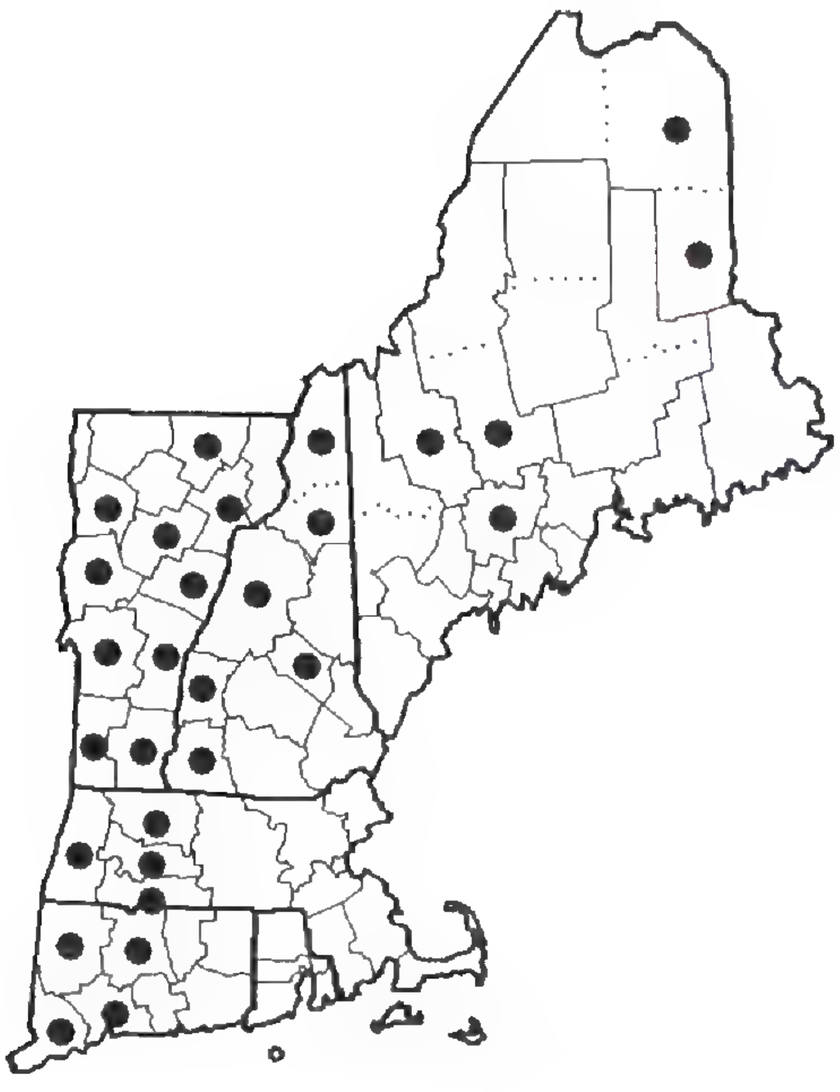


Equisetum hyemale subsp. *affine*

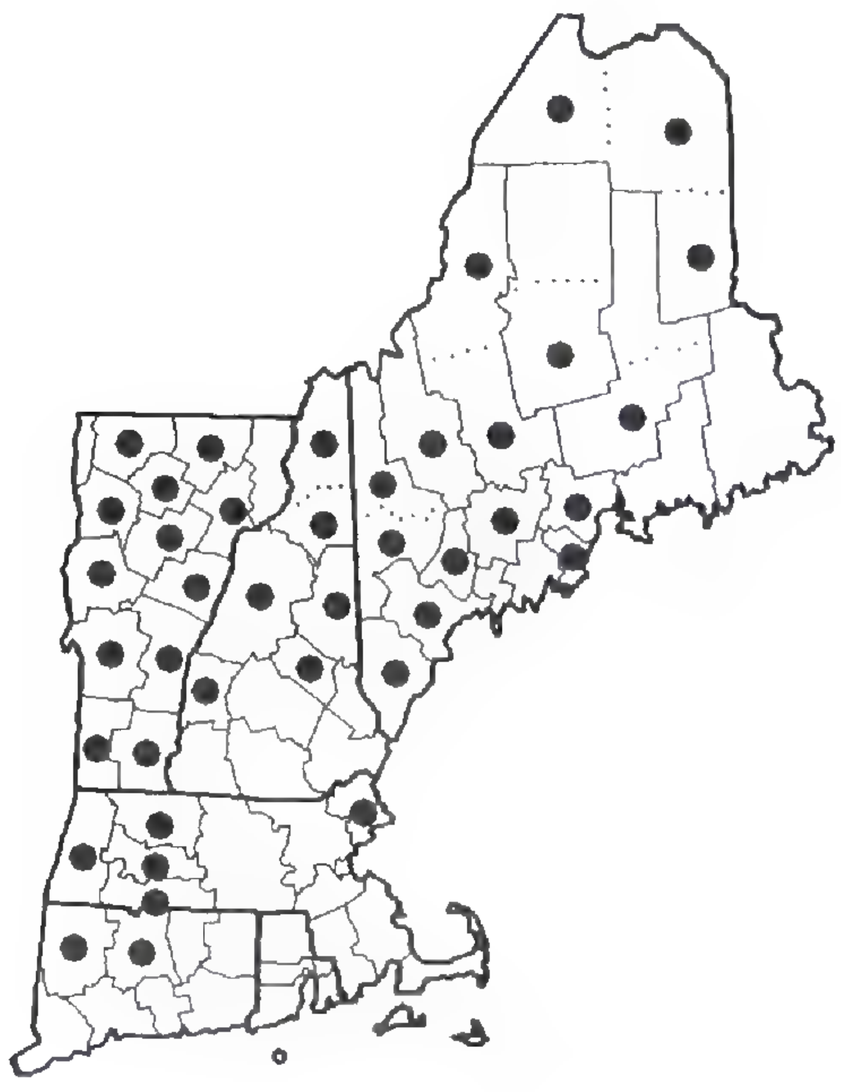


Equisetum palustre

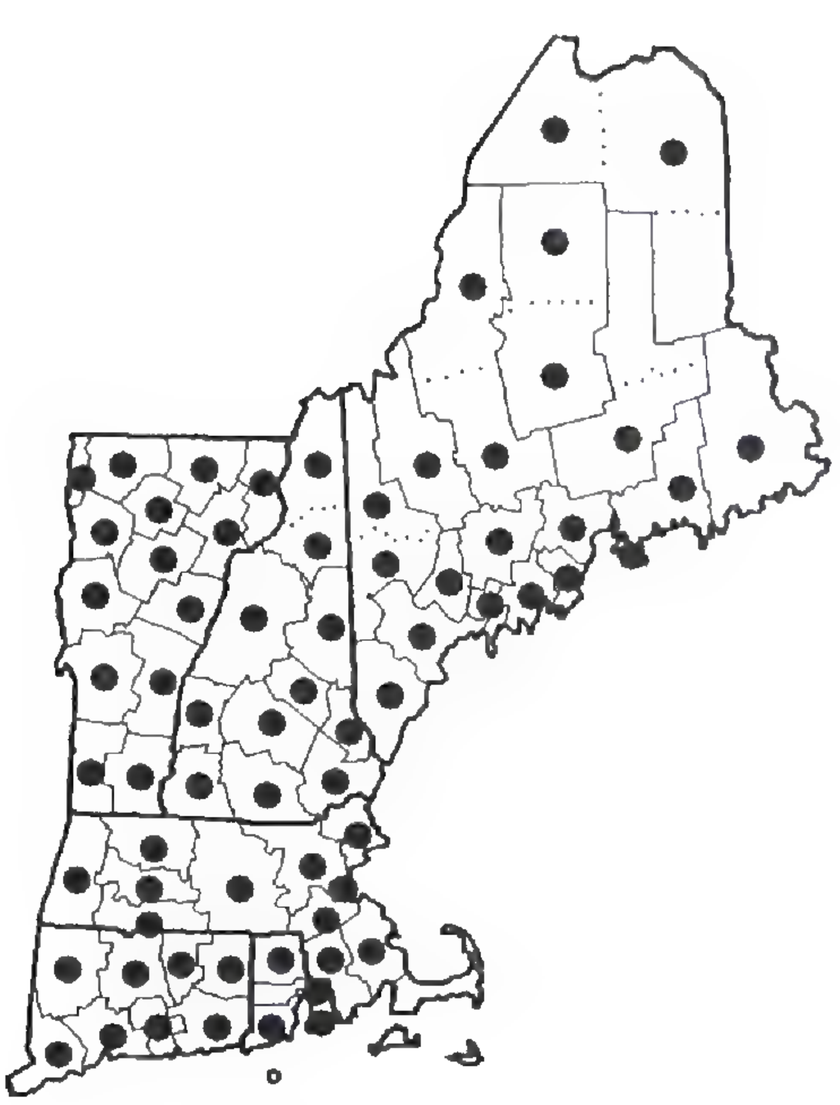
Figure 12. Distribution maps for *Equisetum arvense*, *E. fluviatile*, *E. hyemale* subsp. *affine*, and *E. palustre*.



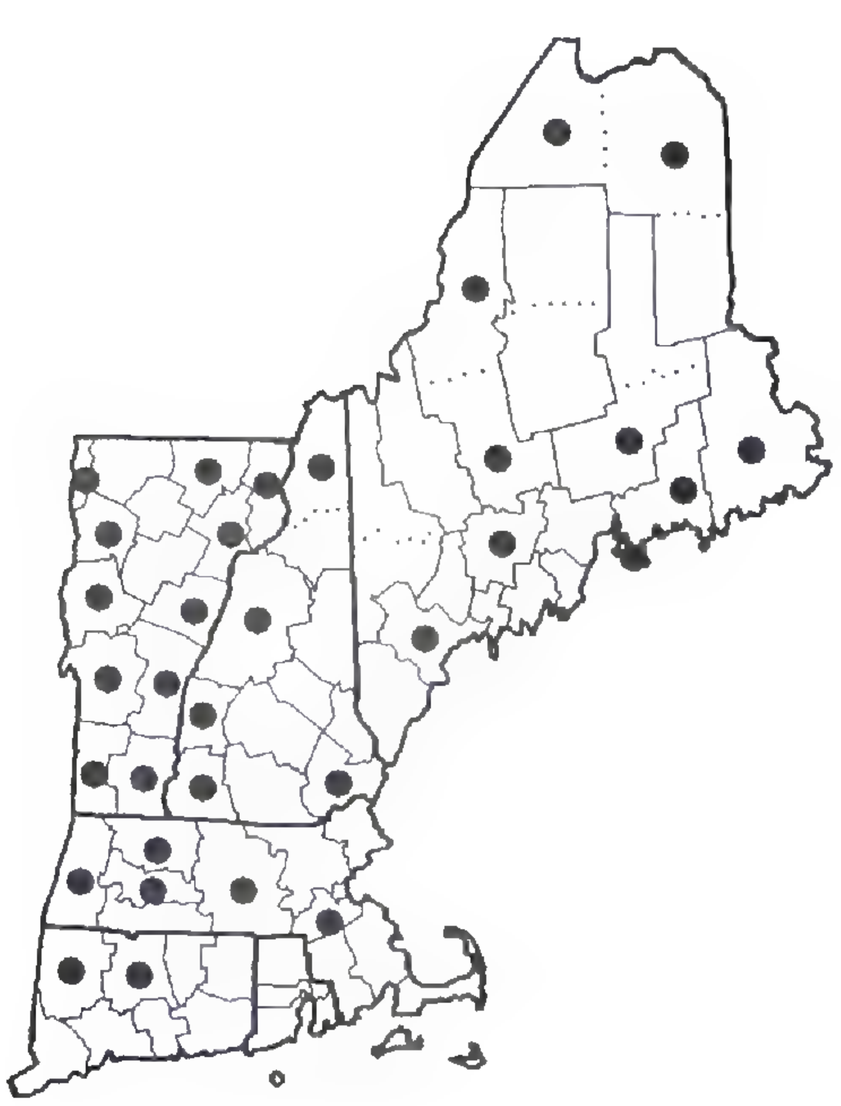
Equisetum pratense



Equisetum scirpoides

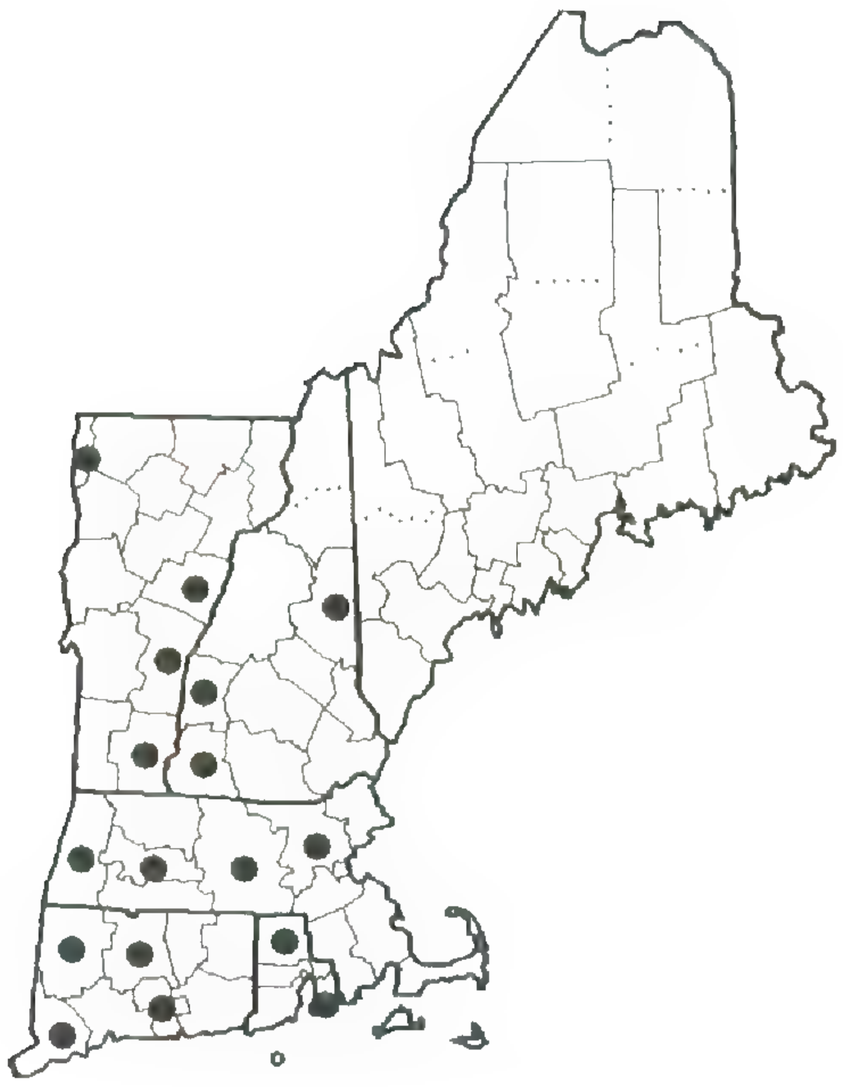


Equisetum sylvaticum

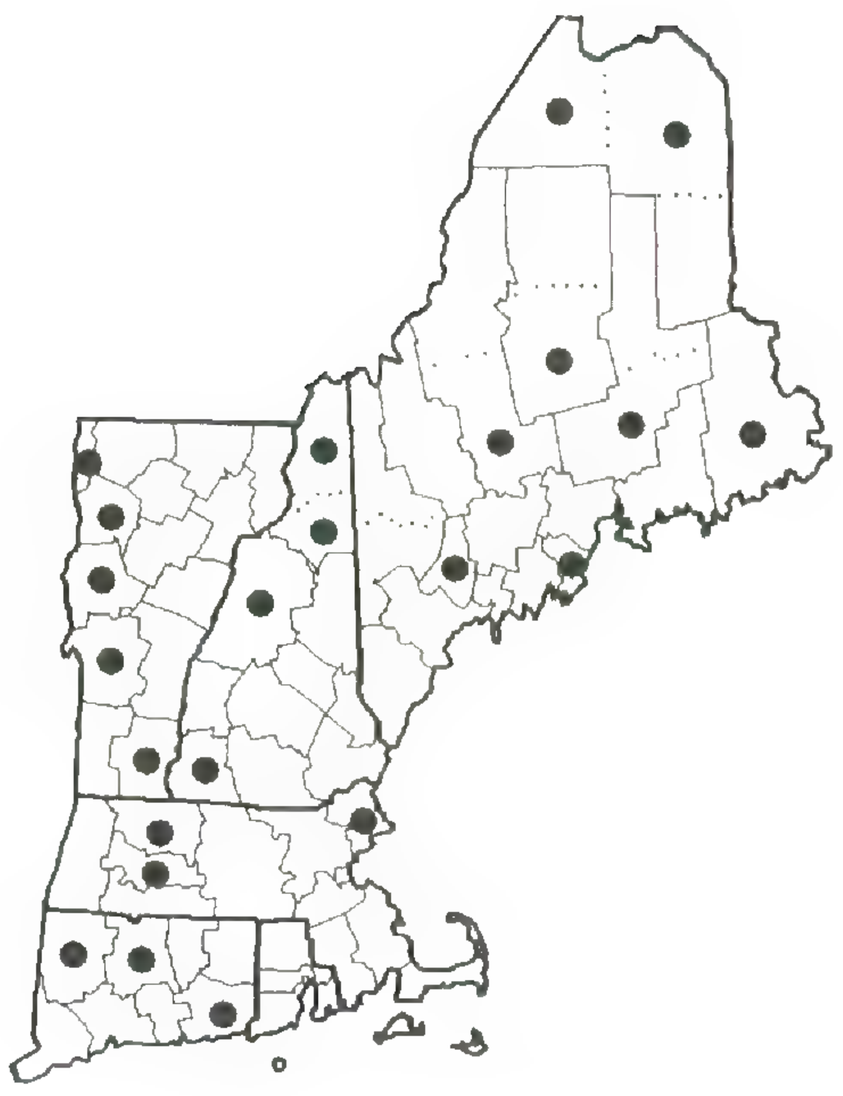


Equisetum variegatum

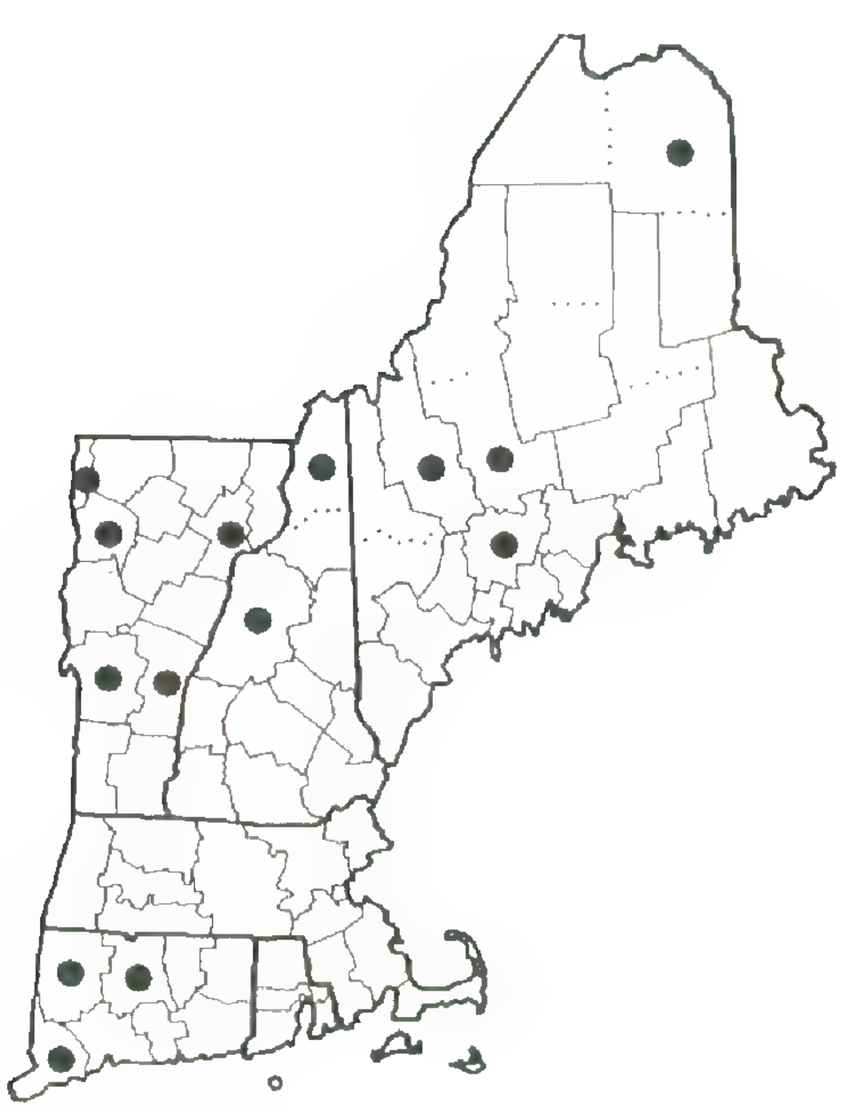
Figure 13. Distribution maps for *Equisetum pratense*, *E. scirpoides*, *E. sylvaticum*, and *E. variegatum*.



Equisetum x *ferrissii*



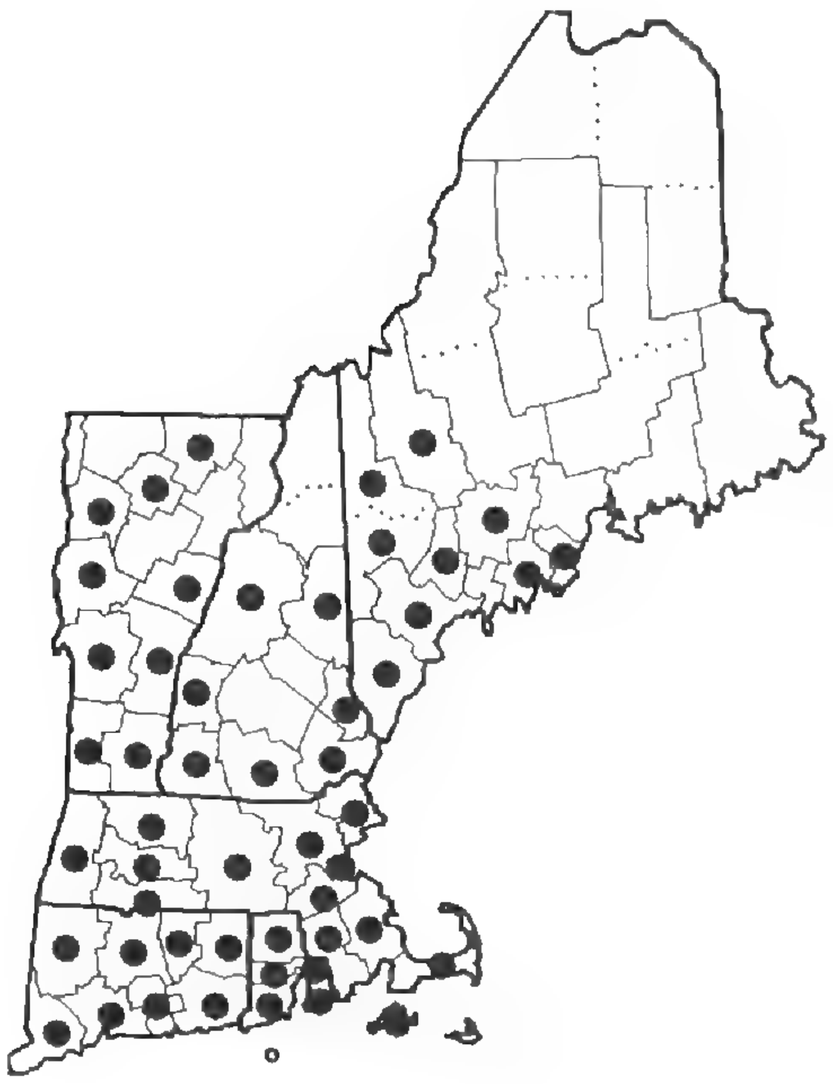
Equisetum x *litorale*



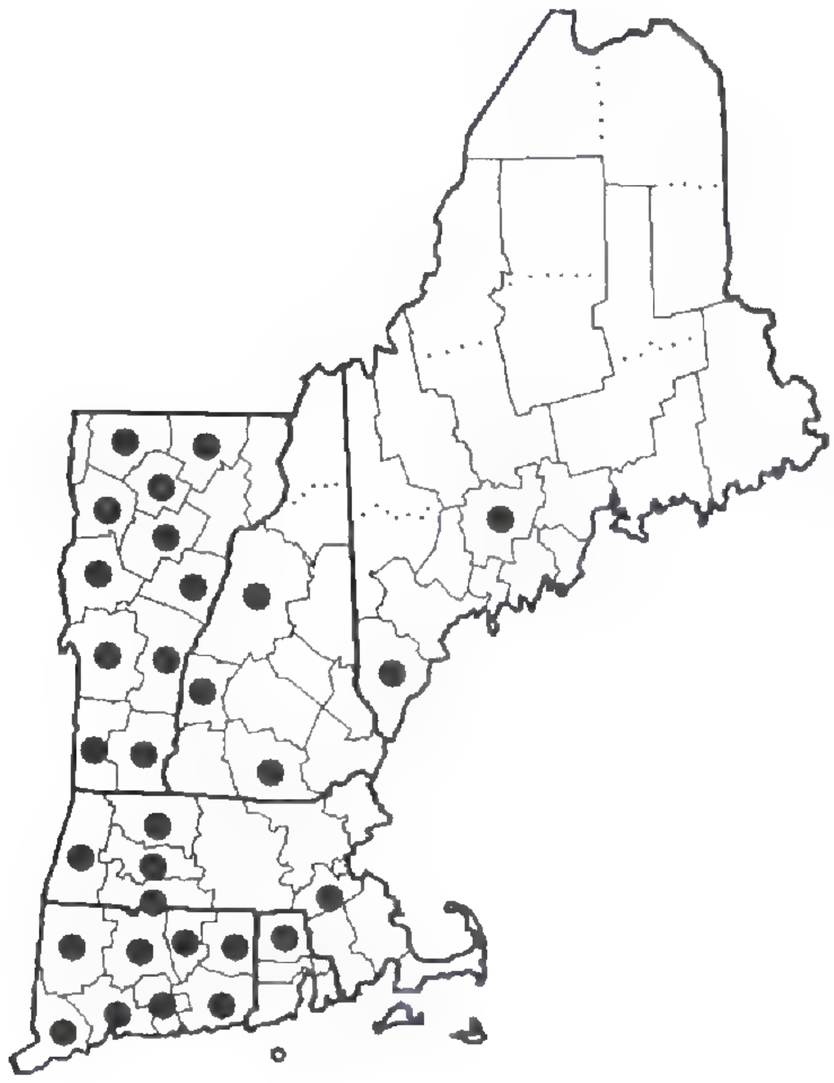
Equisetum x *mackaii*

Asplenium montanum

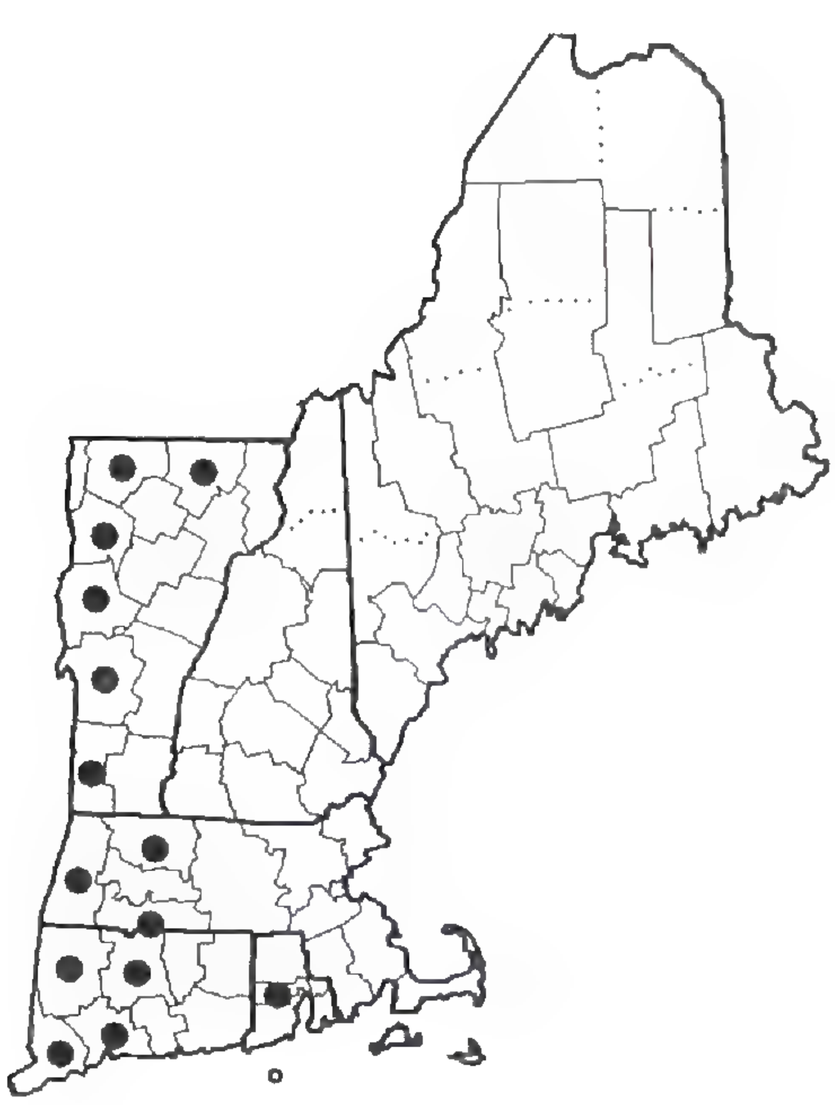
Figure 14. Distribution maps for *Equisetum* × *ferrissii*, *E.* × *litorale*, *E.* × *mackaii*, and *Asplenium montanum*.



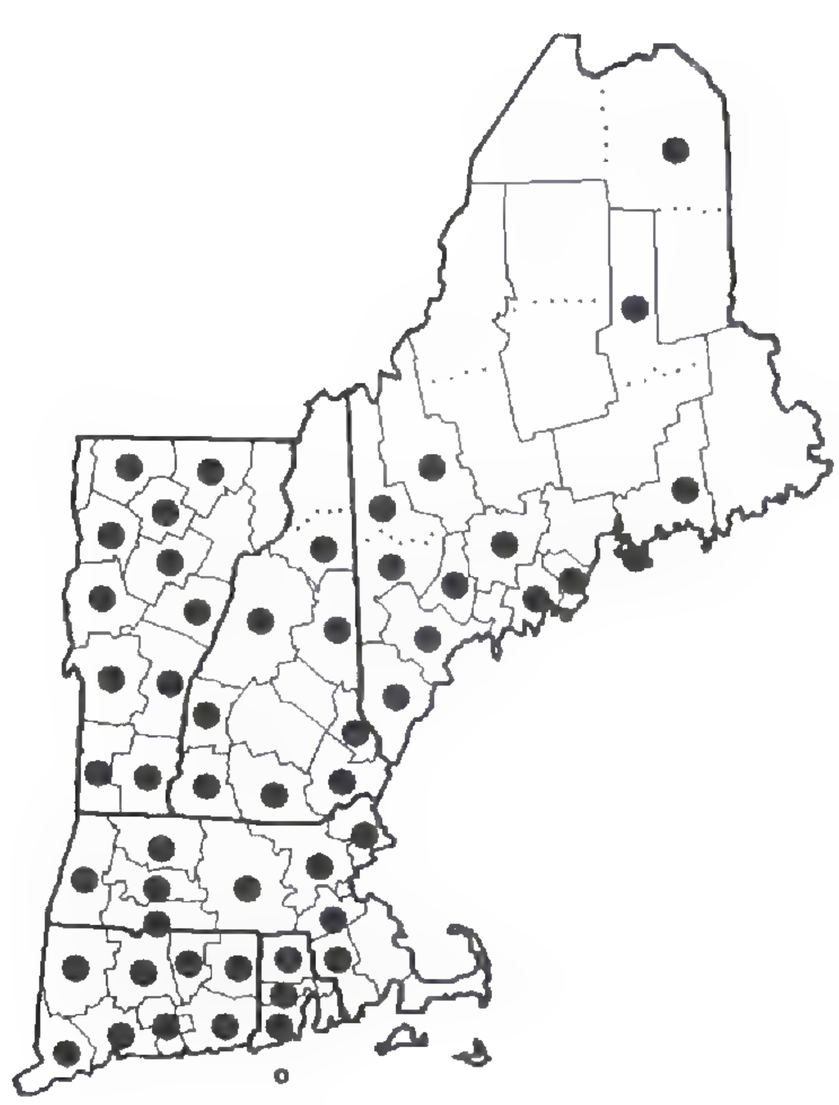
Asplenium platyneuron



Asplenium rhizophyllum

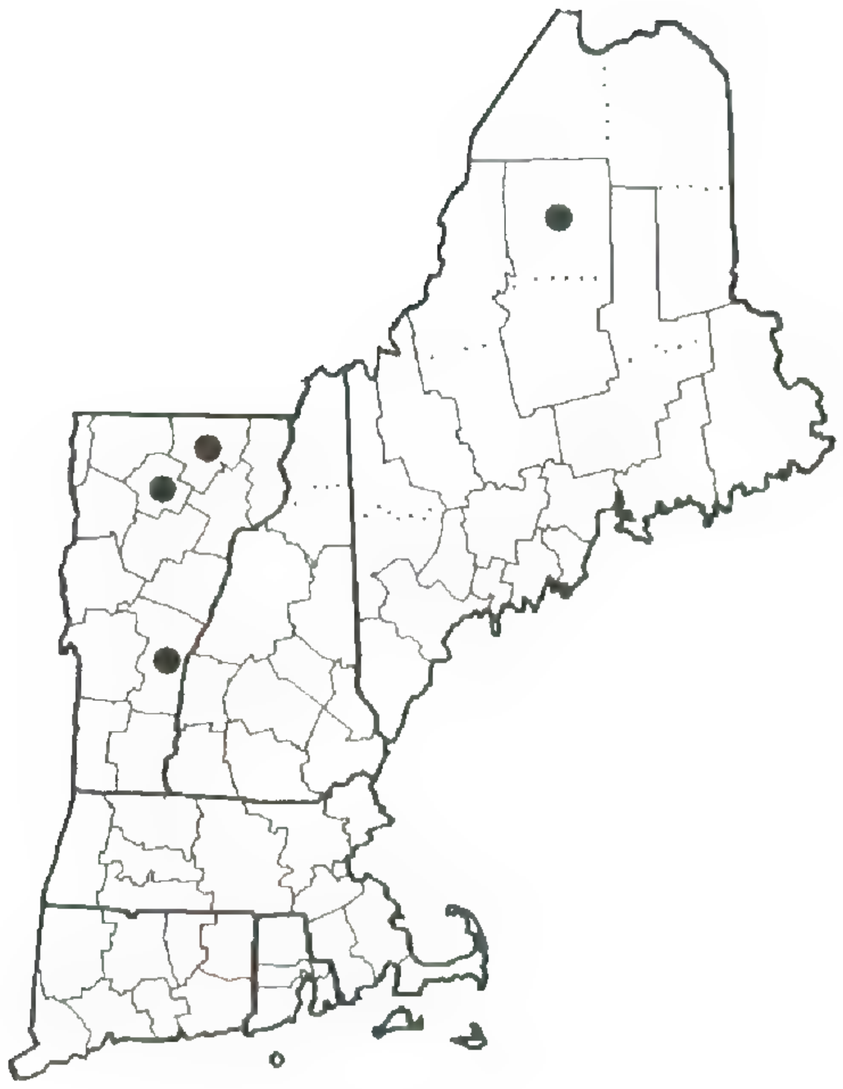


Asplenium ruta-muraria

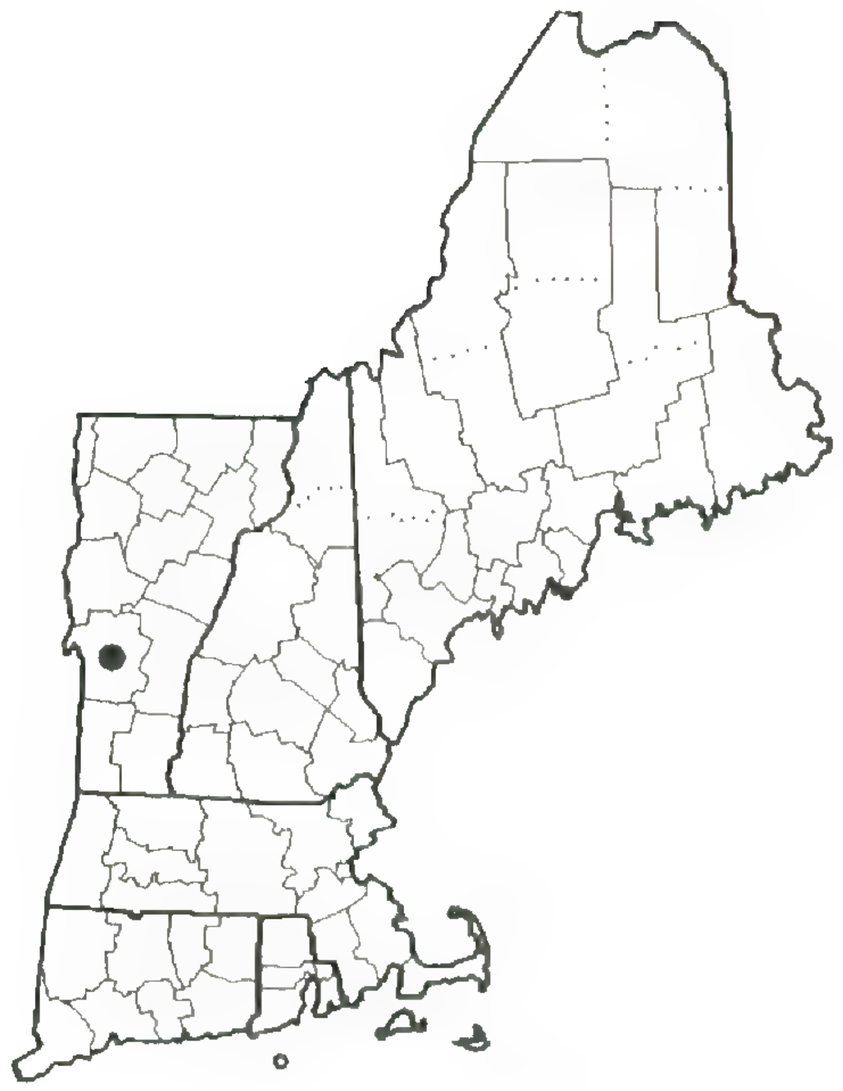


Asplenium trichomanes

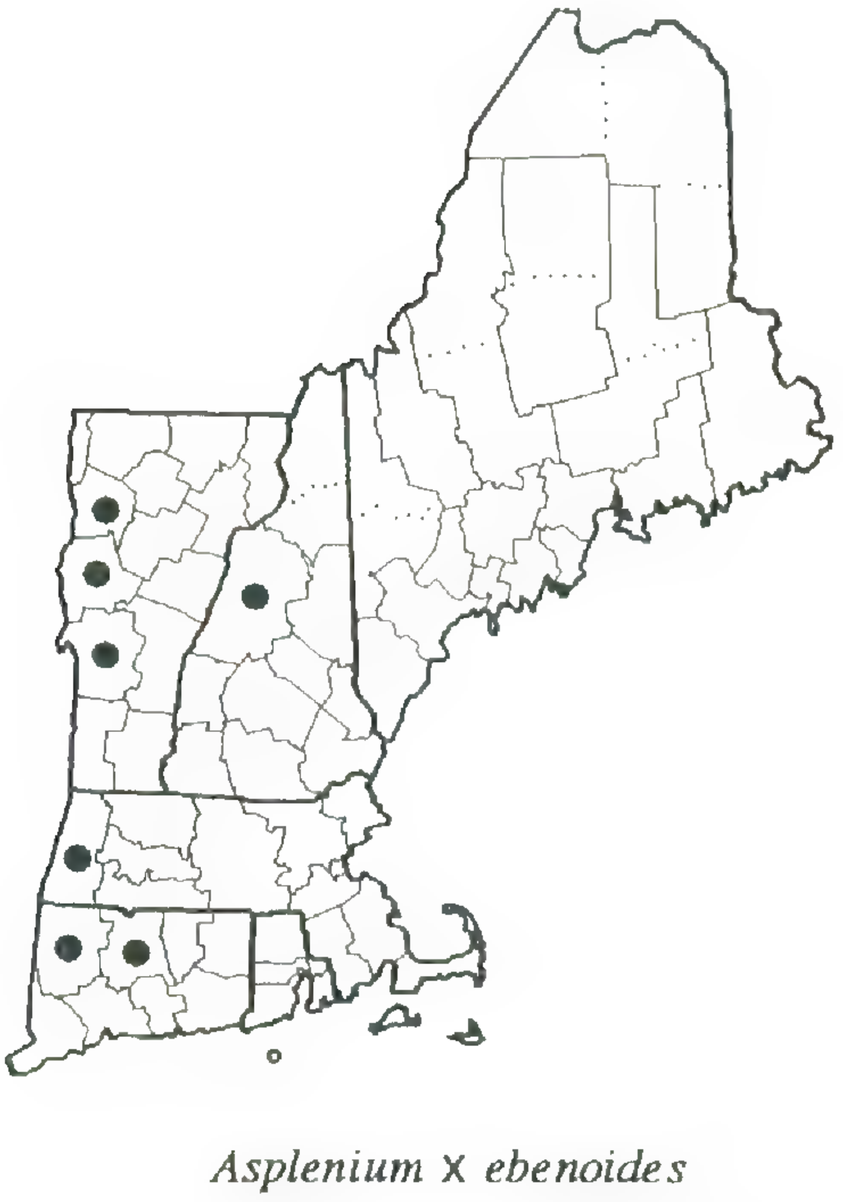
Figure 15. Distribution maps for *Asplenium platyneuron*, *A. rhizophyllum*, *A. ruta-muraria*, and *A. trichomanes*.



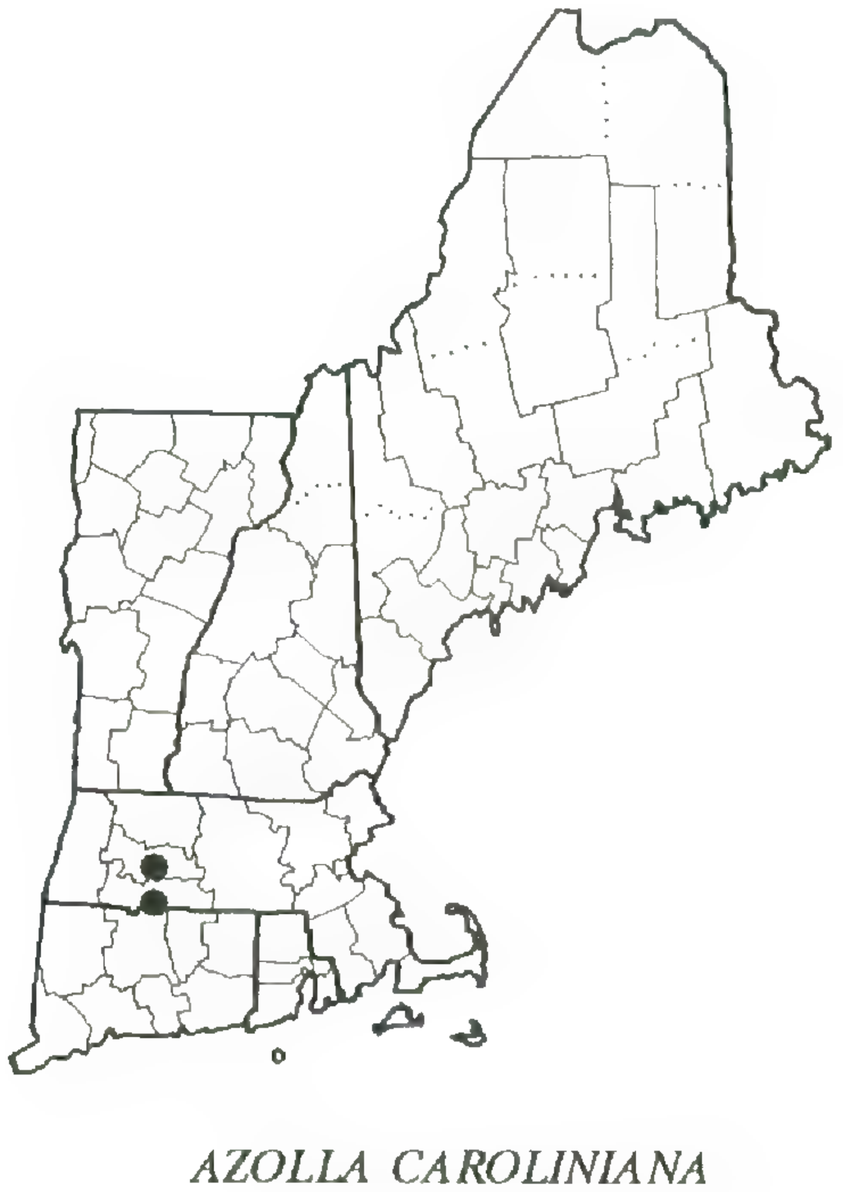
Asplenium trichomanes-ramosum



Asplenium x *clermontae*

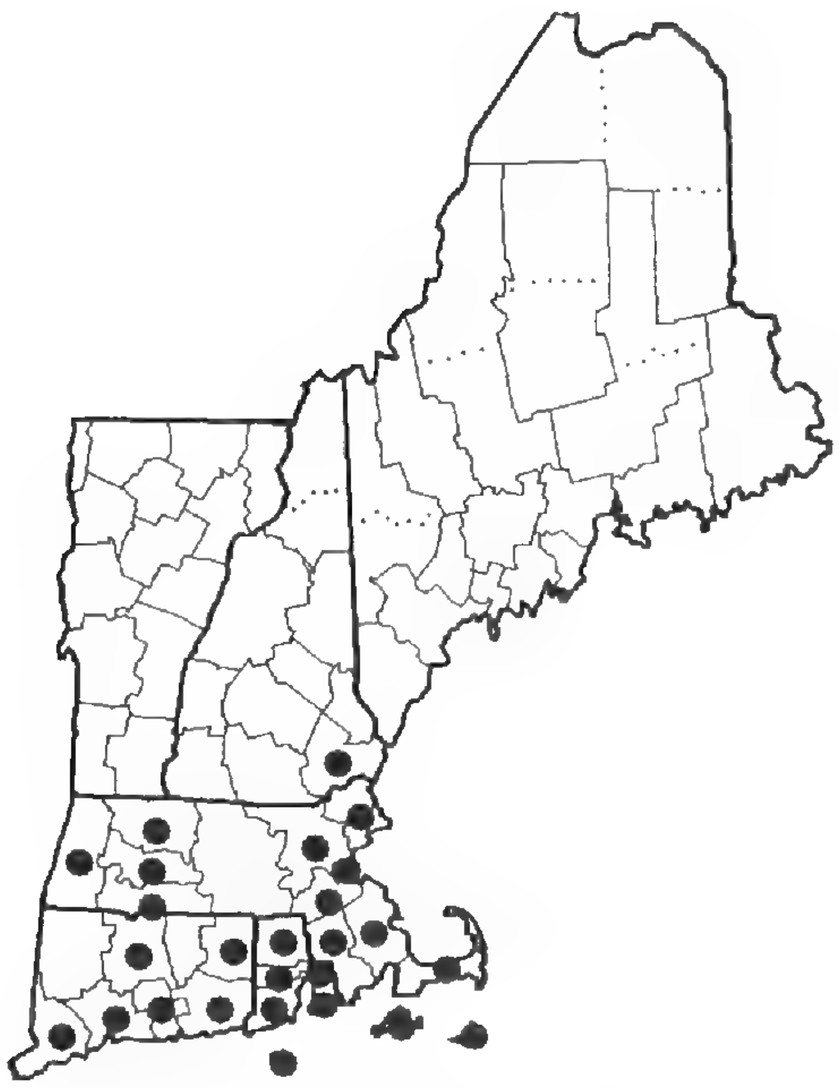


Asplenium x *ebenoides*

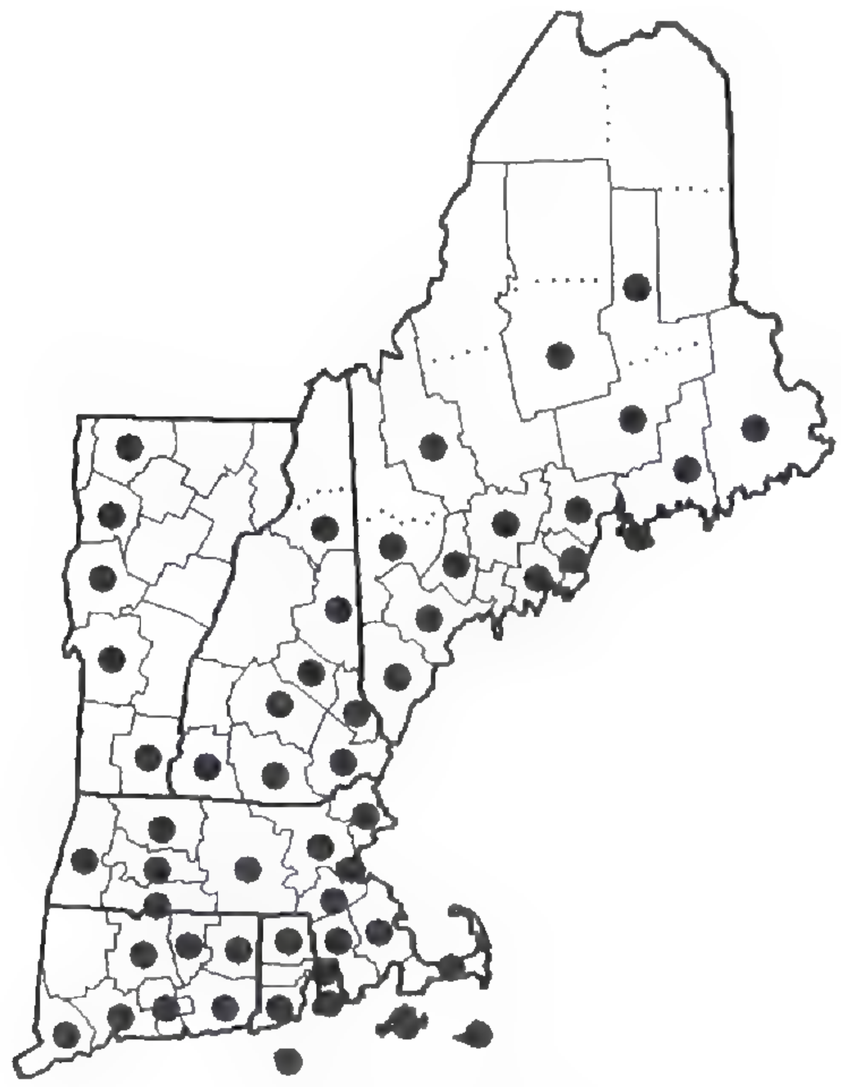


AZOLLA CAROLINIANA

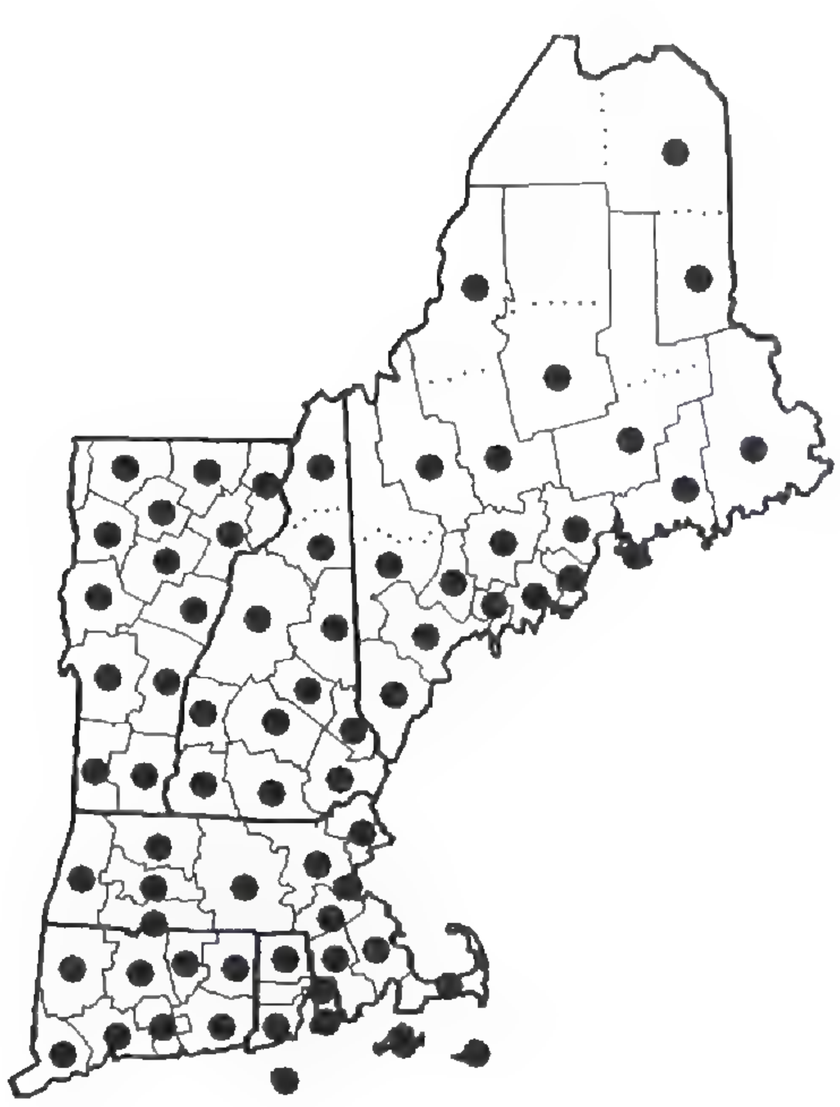
Figure 16. Distribution maps for *Asplenium trichomanes-ramosum*, *A.* × *clermontae*, *A.* × *ebenoides*, and *AZOLLA CAROLINIANA*.



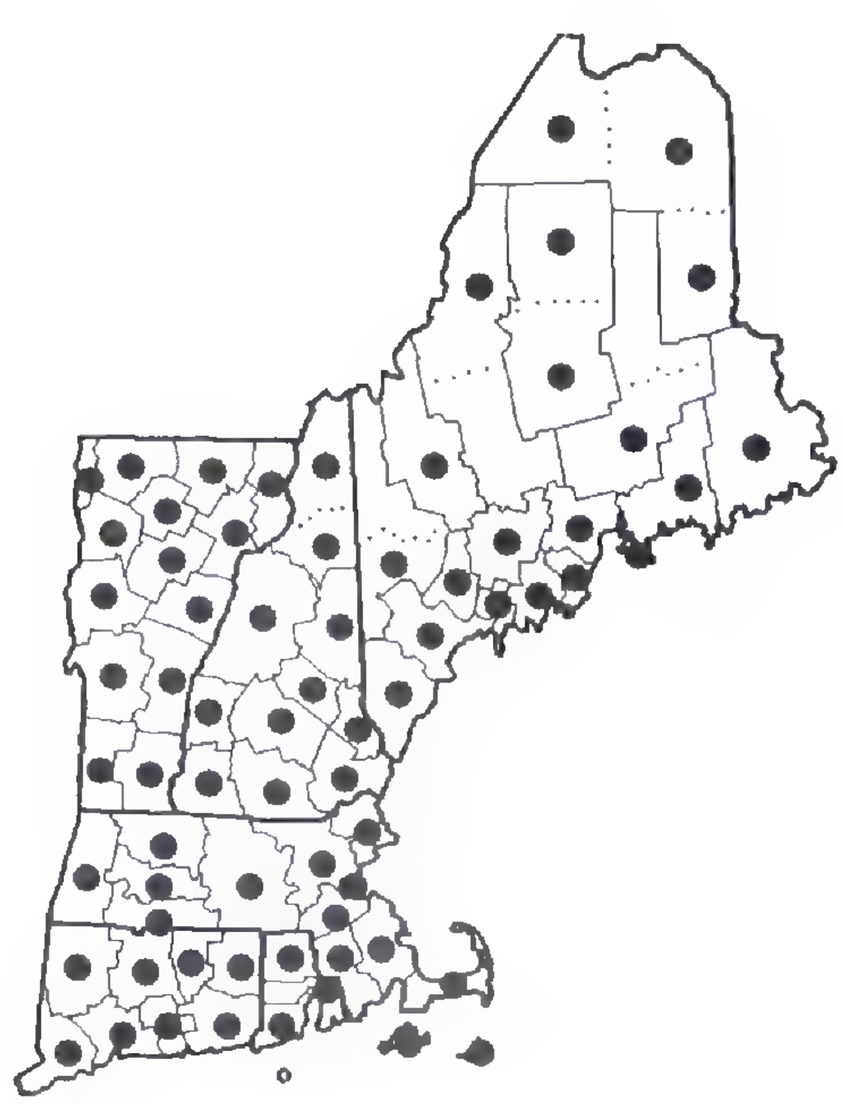
Woodwardia areolata



Woodwardia virginica

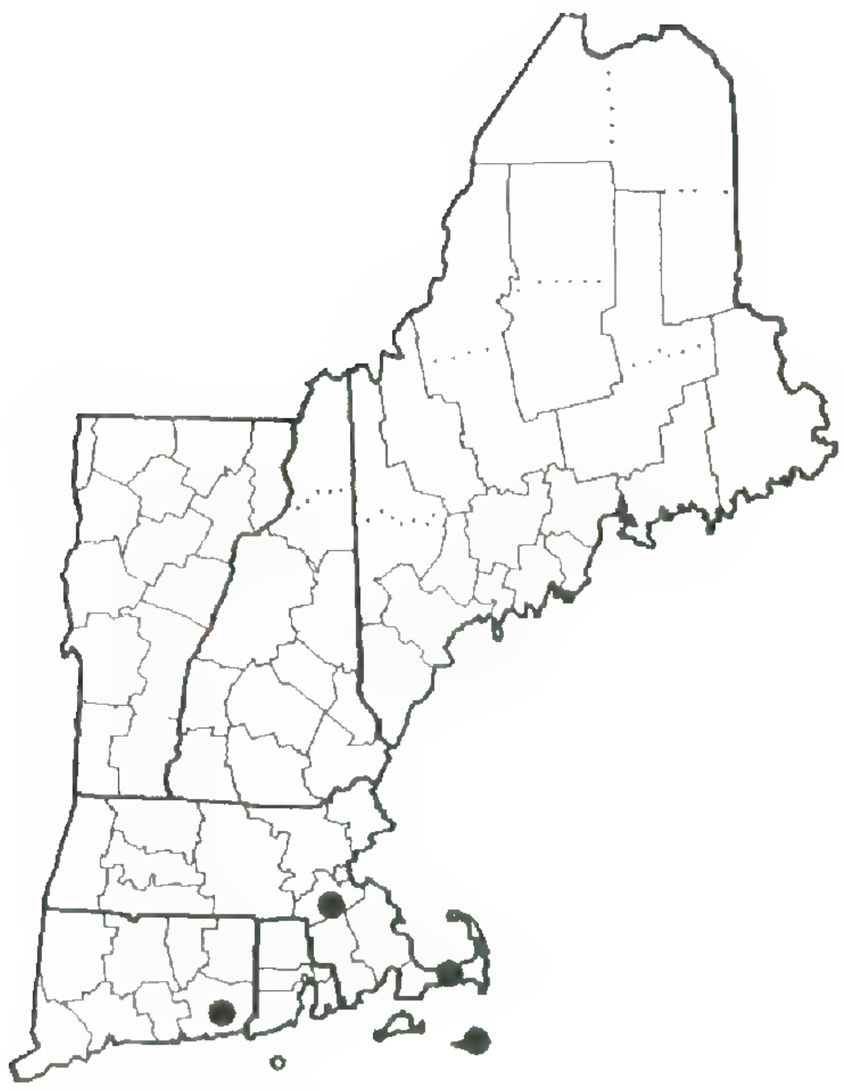


Dennstaedtia punctilobula

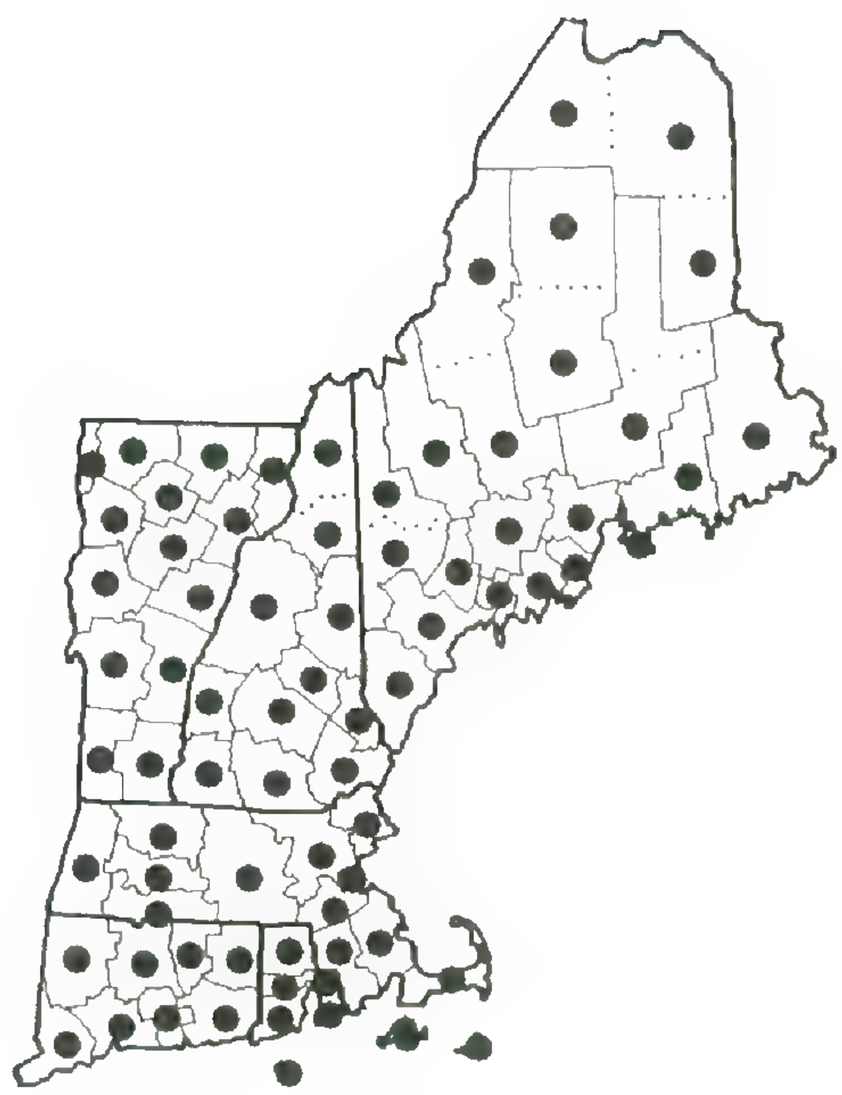


Pteridium aquilinum subsp. *latiusculum*

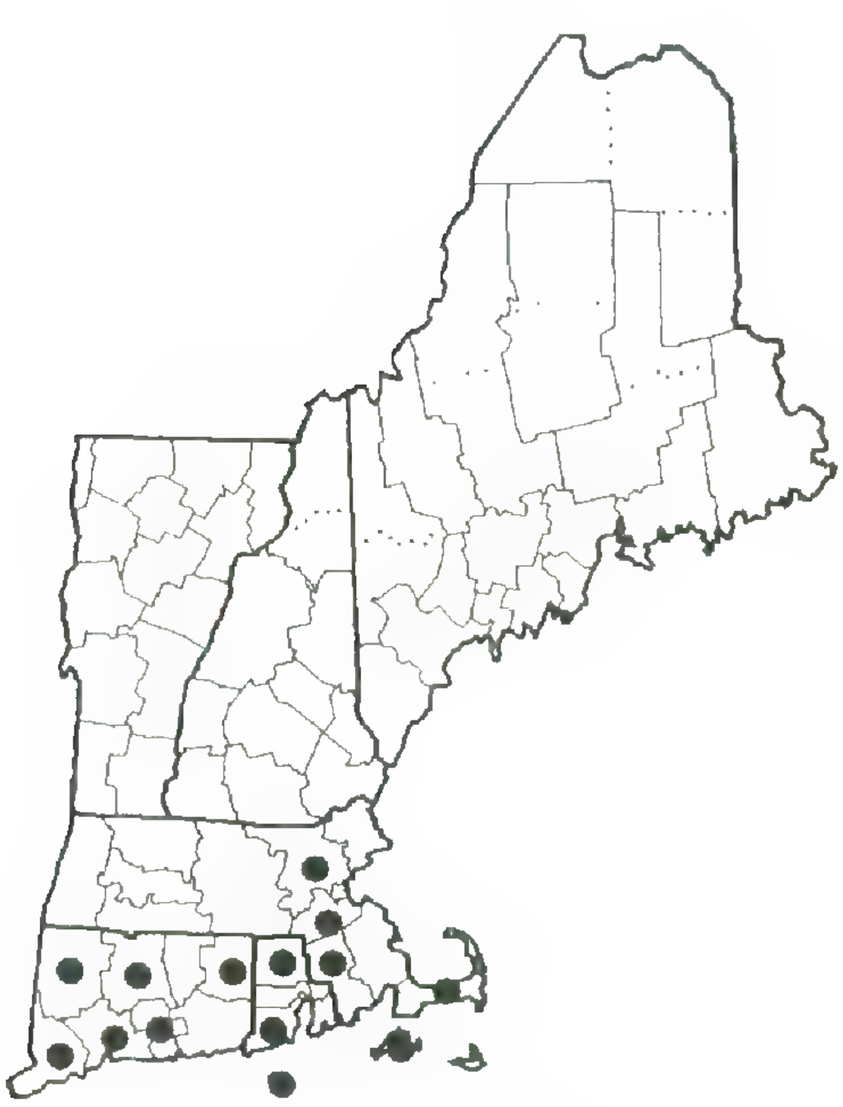
Figure 17. Distribution maps for *Woodwardia areolata*, *W. virginica*, *Dennstaedtia punctilobula*, and *Pteridium aquilinum* subsp. *latiusculum*.



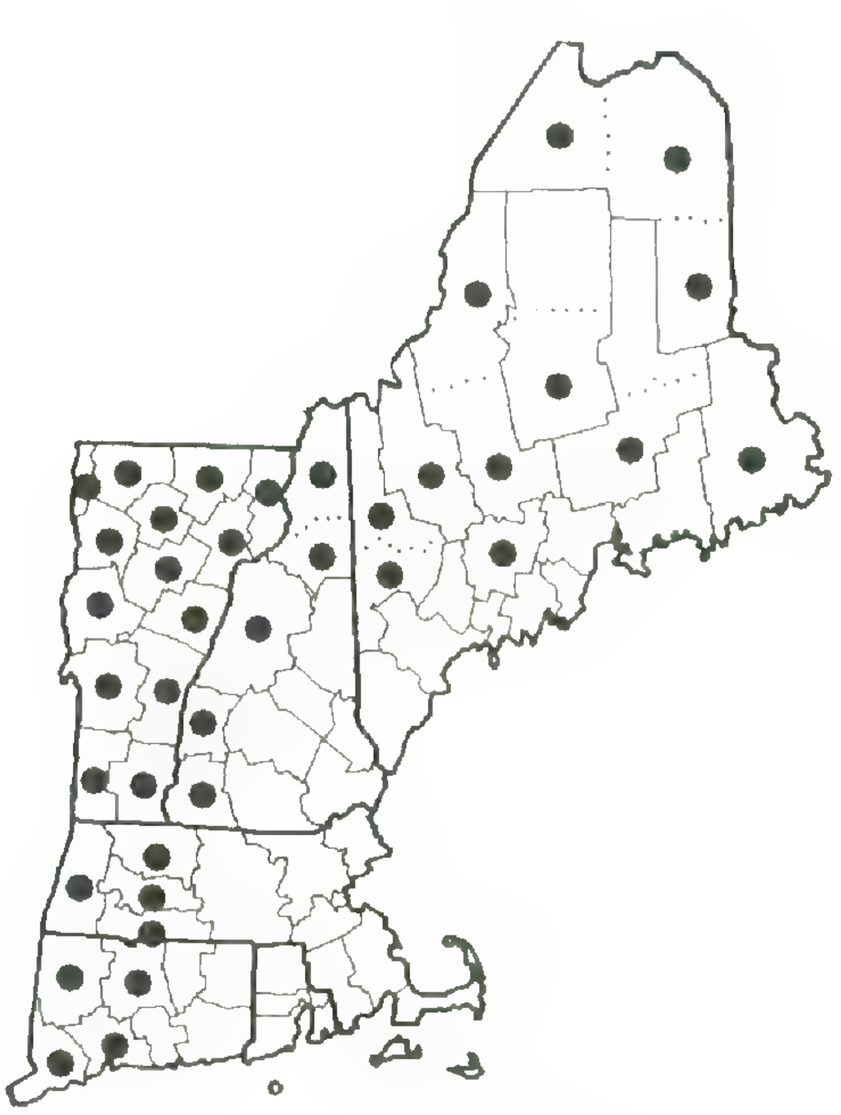
Pteridium aquilinum
subsp. *pseudocaudatum*



Athyrium filix-femina
subsp. *angustum*

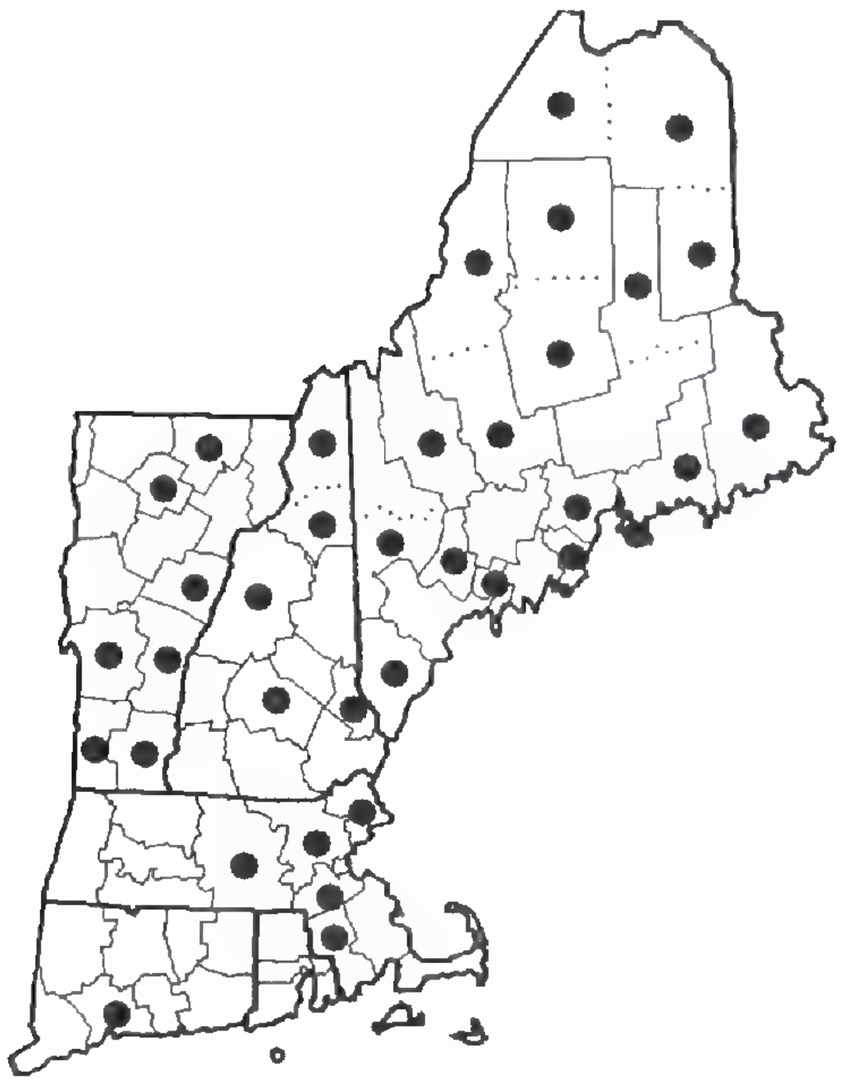


Athyrium filix-femina
subsp. *asplenioides*

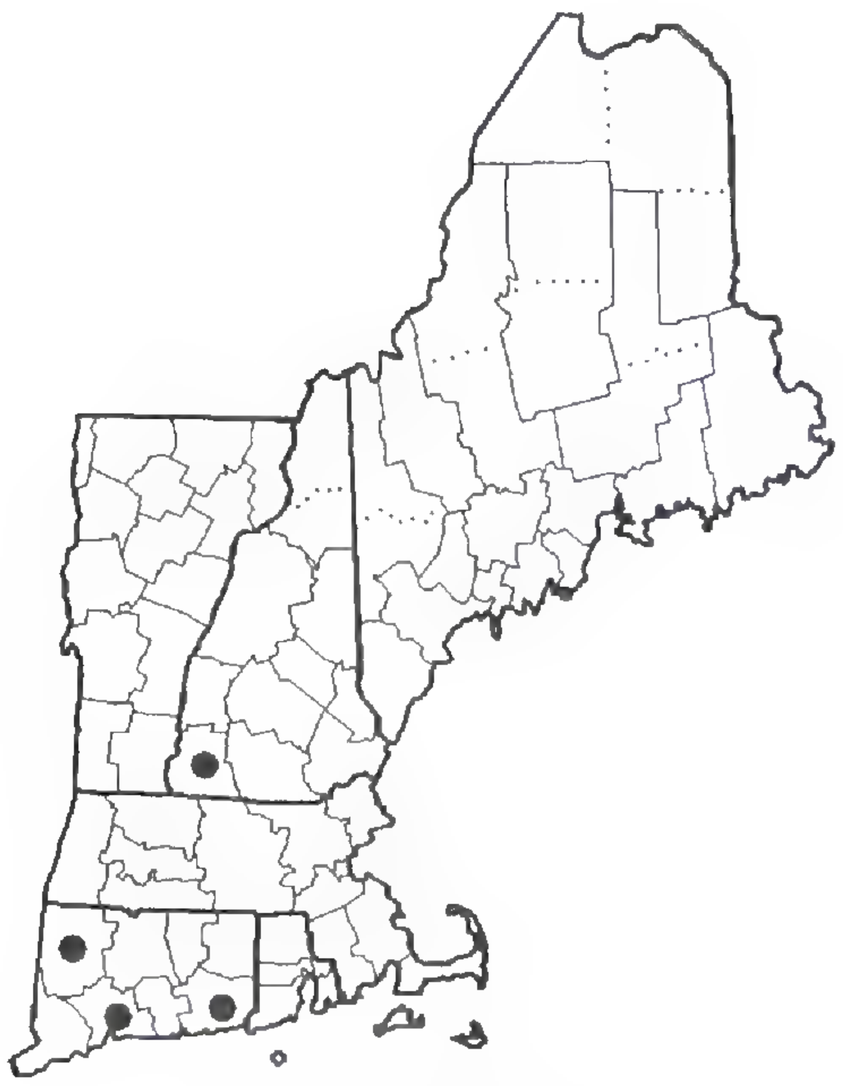


Cystopteris bulbifera

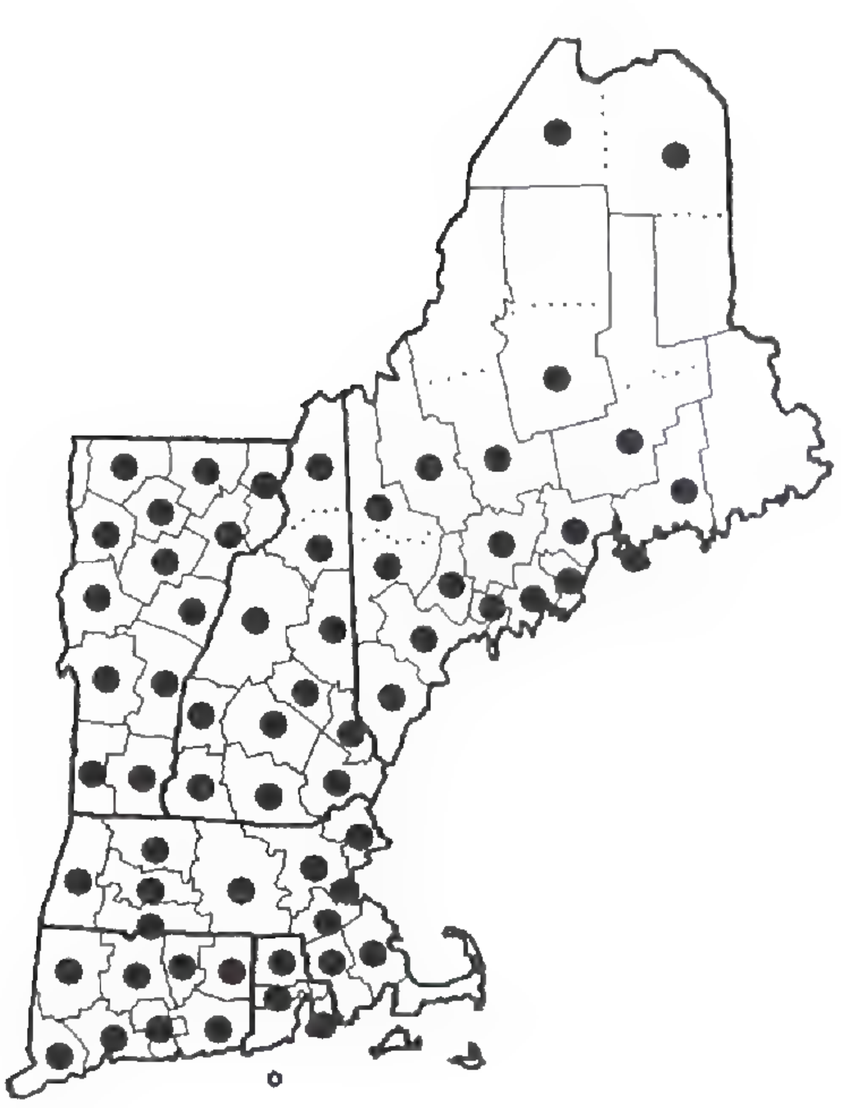
Figure 18. Distribution maps for *Pteridium aquilinum* subsp. *pseudocaudatum*, *Athyrium filix-femina* subsp. *angustum*, *A. filix-femina* subsp. *asplenioides*, and *Cystopteris bulbifera*.



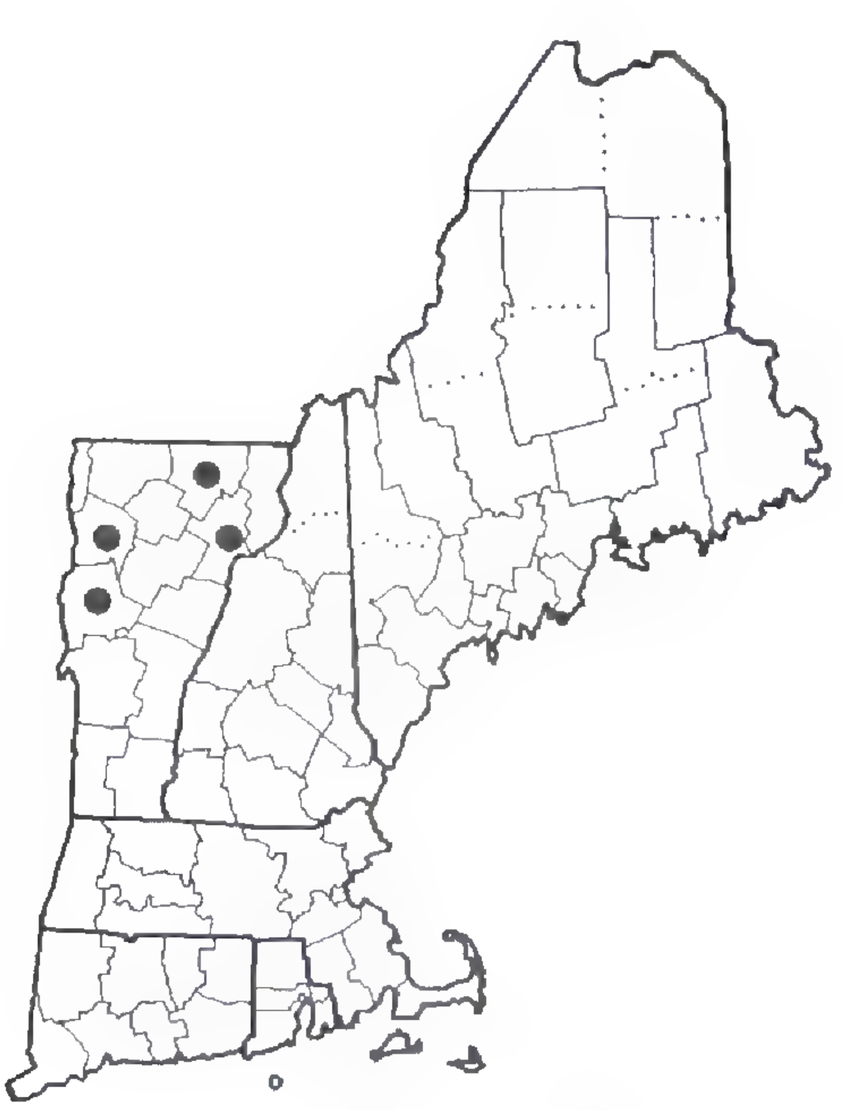
Cystopteris fragilis



Cystopteris protrusa

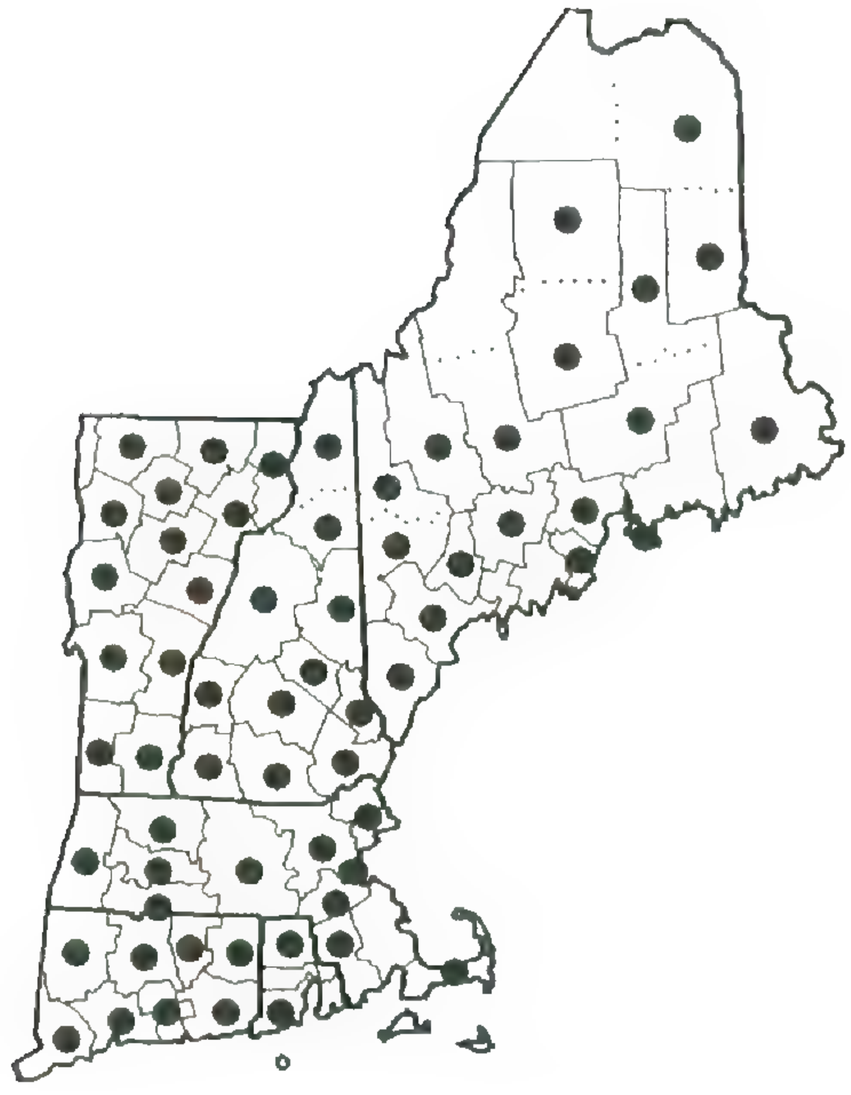


Cystopteris tenuis

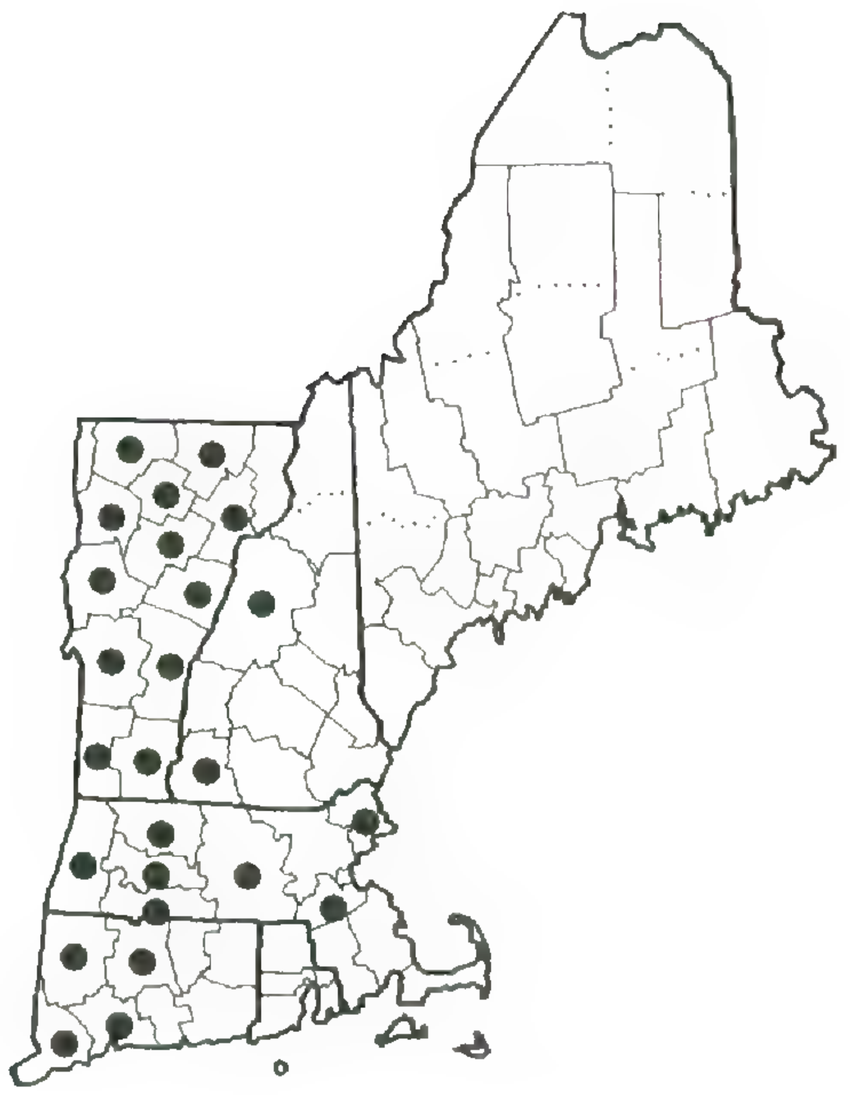


Cystopteris fragilis x *C. tenuis*

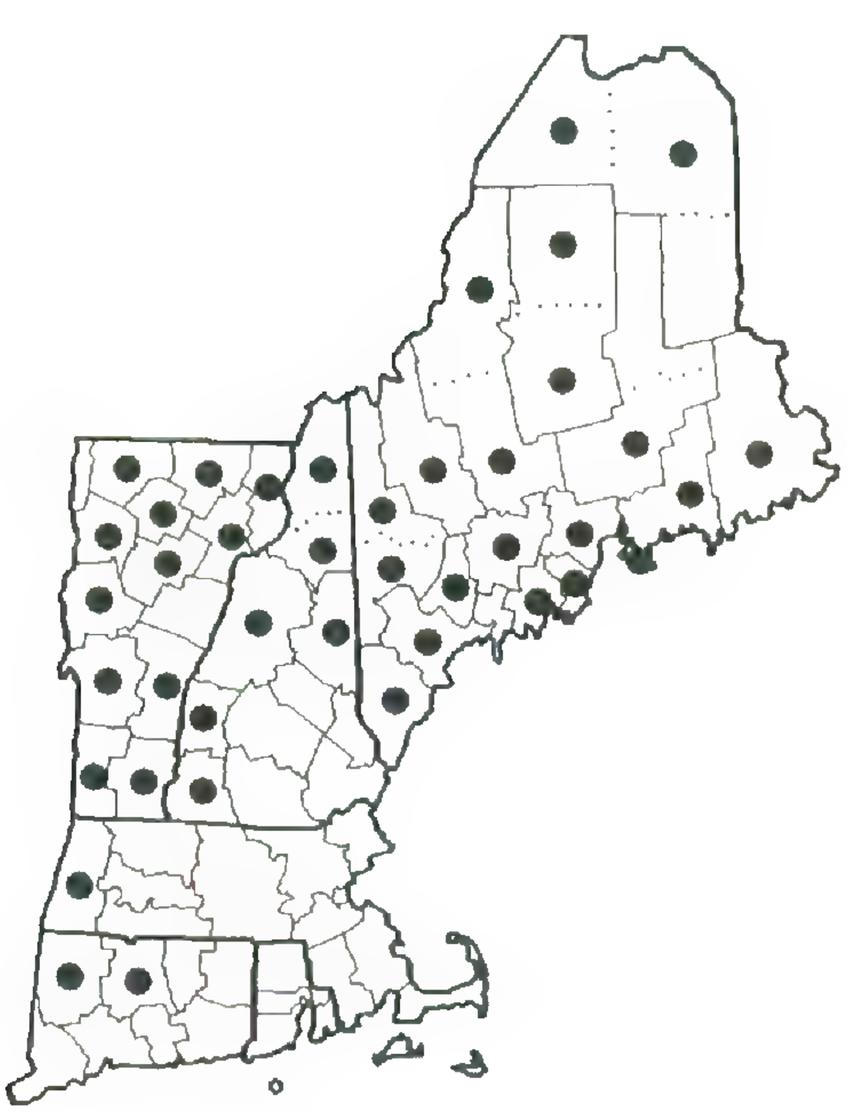
Figure 19. Distribution maps for *Cystopteris fragilis, C. protrusa, C. tenuis,* and *C. fragilis* × *C. tenuis.*



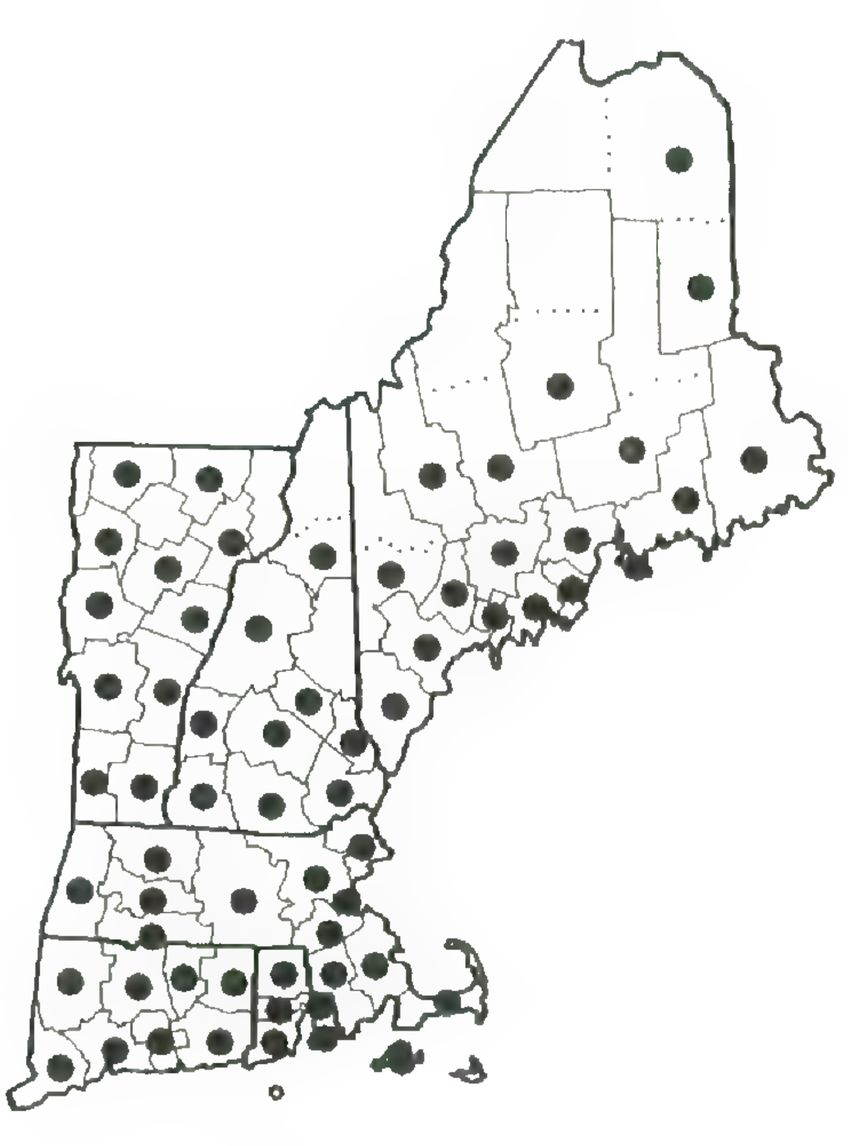
Deparia acrostichoides



Diplazium pycnocarpon

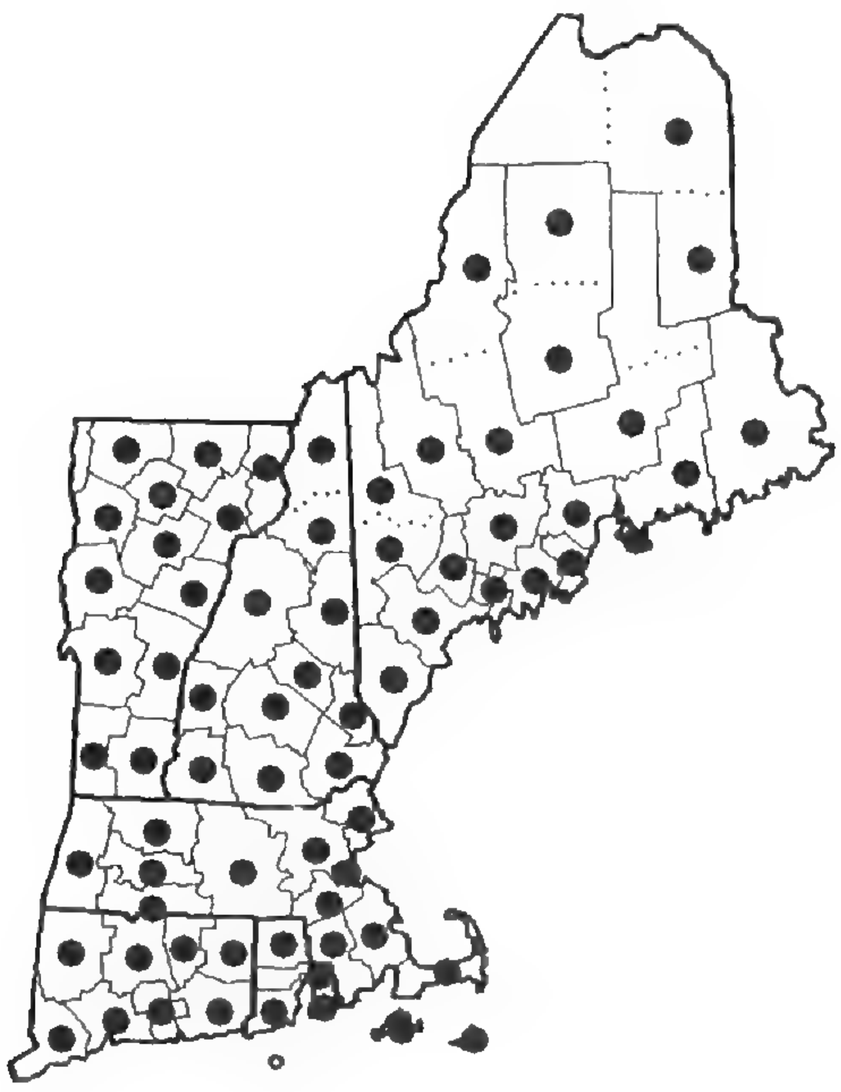


Dryopteris campyloptera

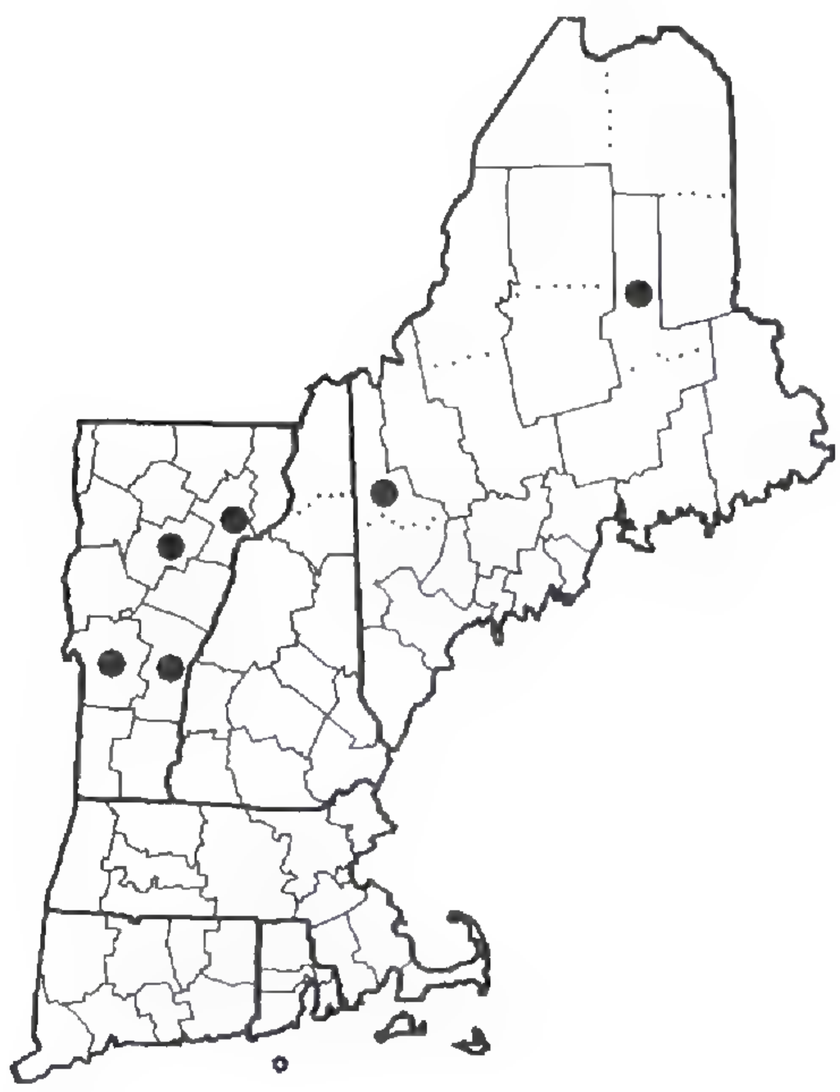


Dryopteris carthusiana

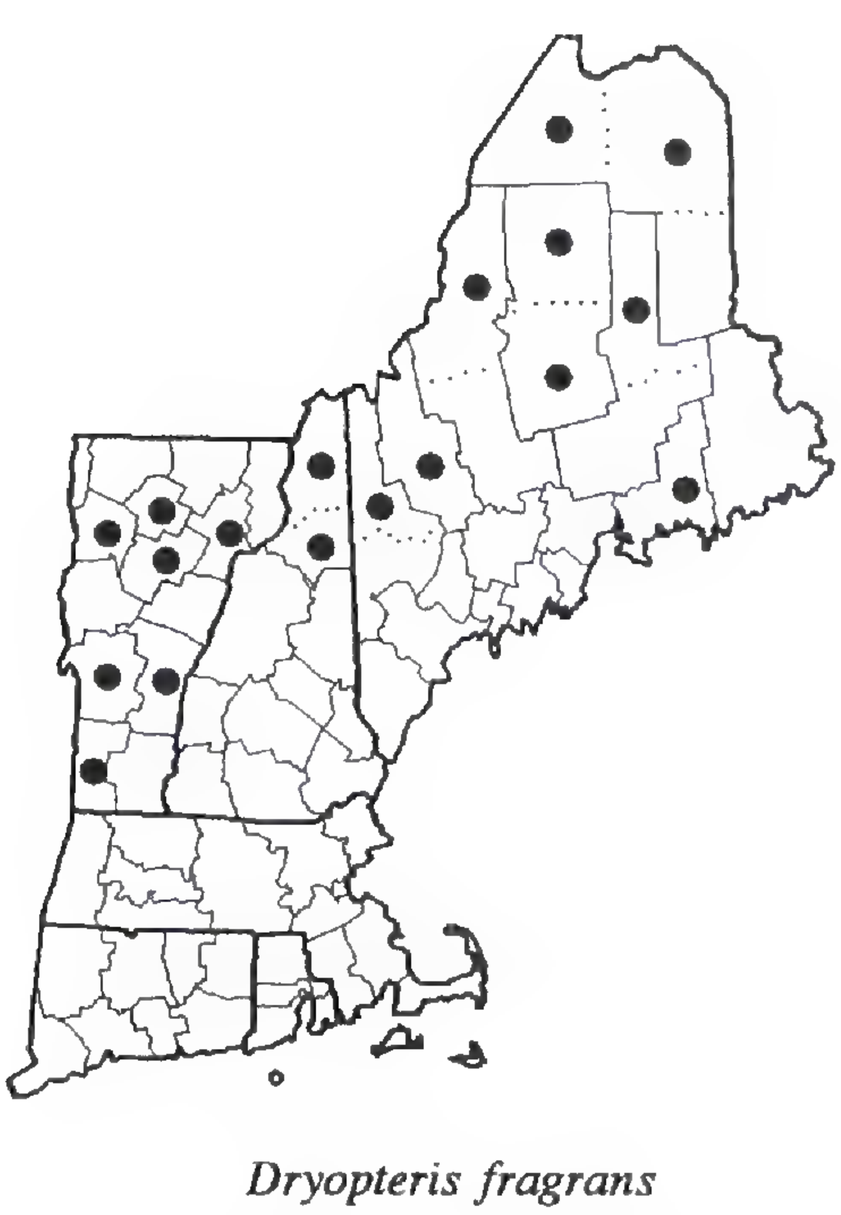
Figure 20. Distribution maps for *Deparia acrostichoides*, *Diplazium pycnocarpon*, *Dryopteris campyloptera*, and *D. carthusiana*.



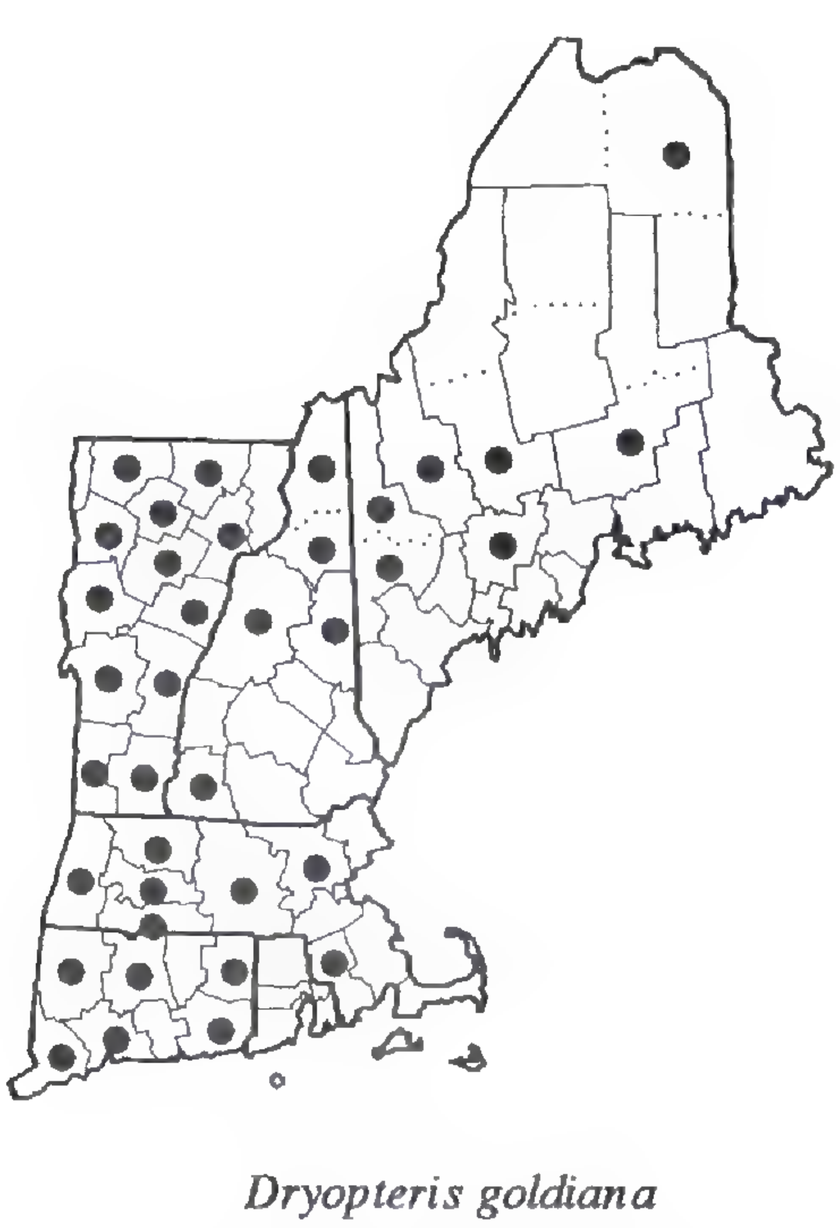
Dryopteris cristata



Dryopteris filix-mas

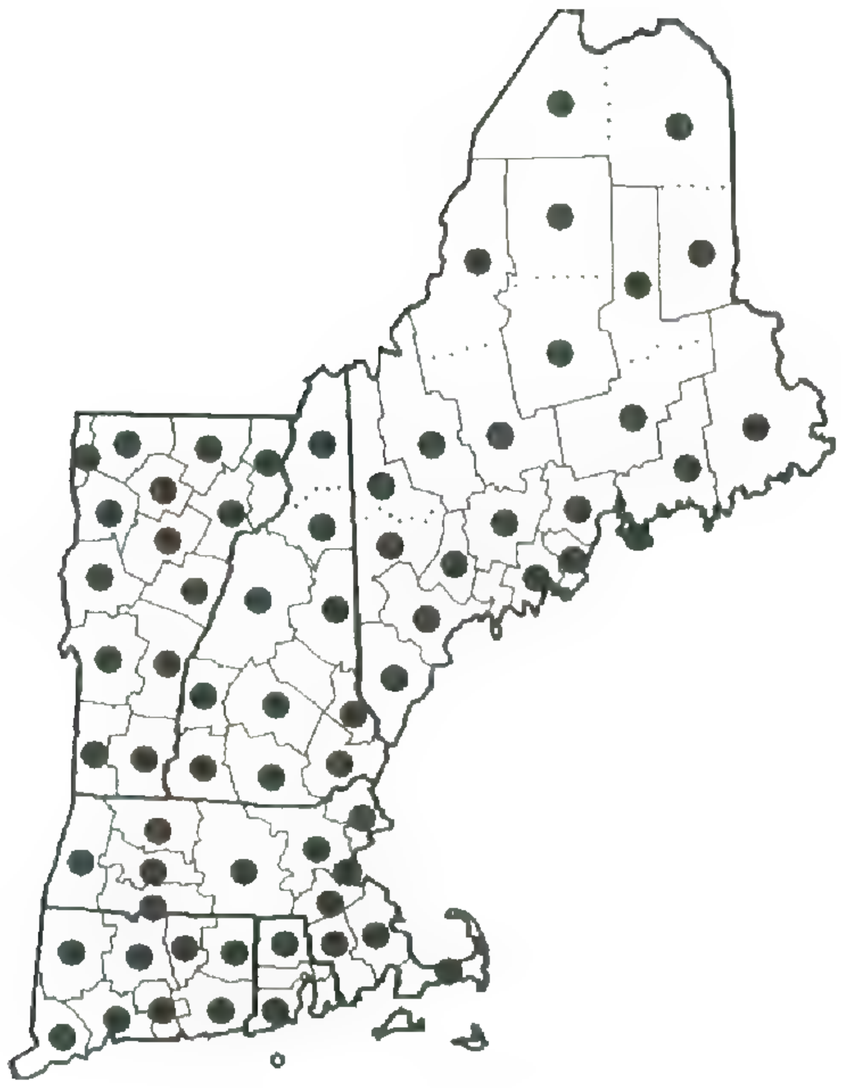


Dryopteris fragrans

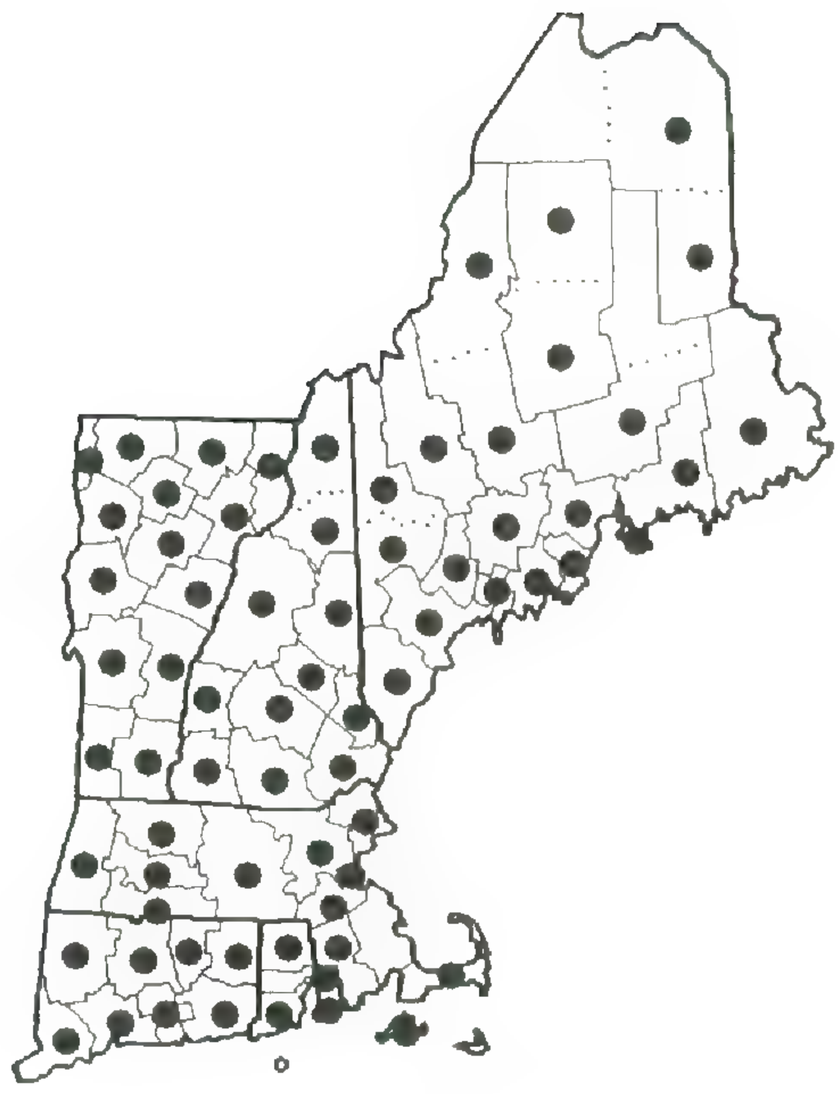


Dryopteris goldiana

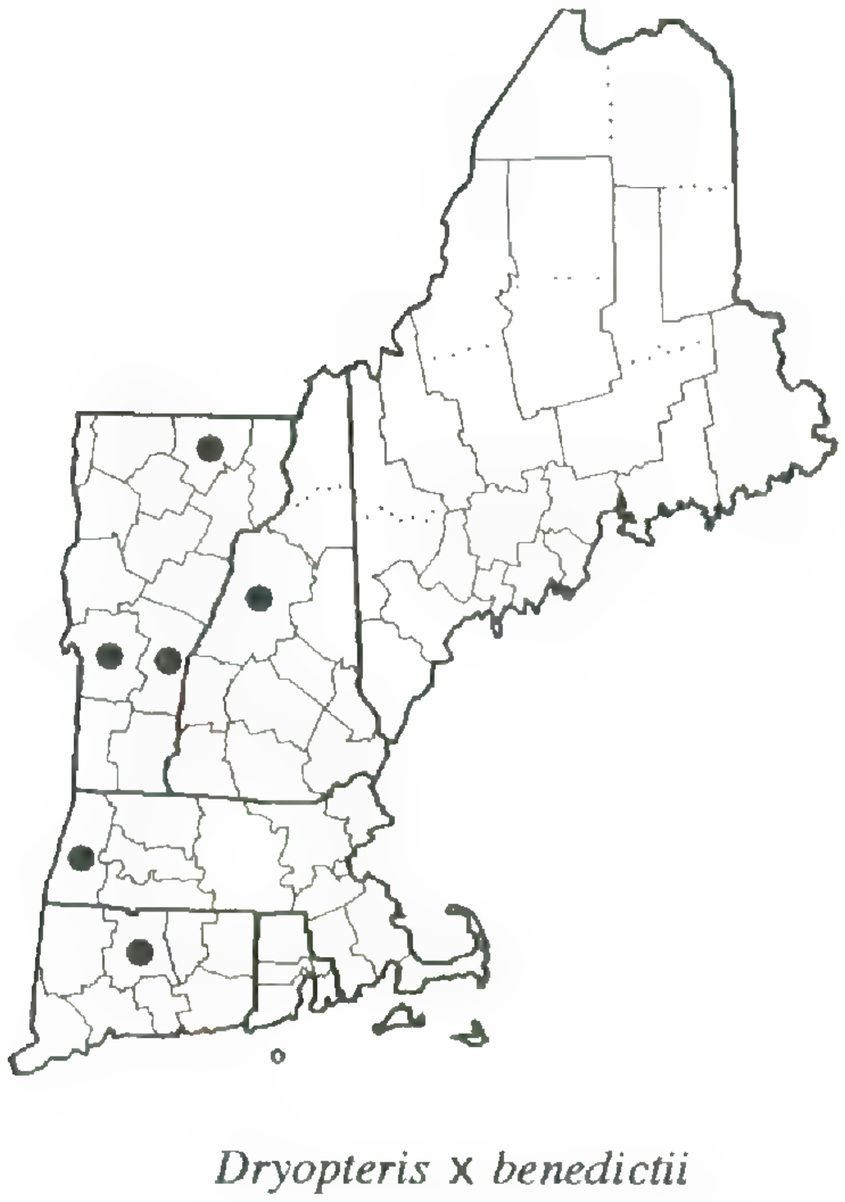
Figure 21. Distribution maps for *Dryopteris cristata*, *D. filix-mas*, *D. fragrans*, and *D. goldiana*.



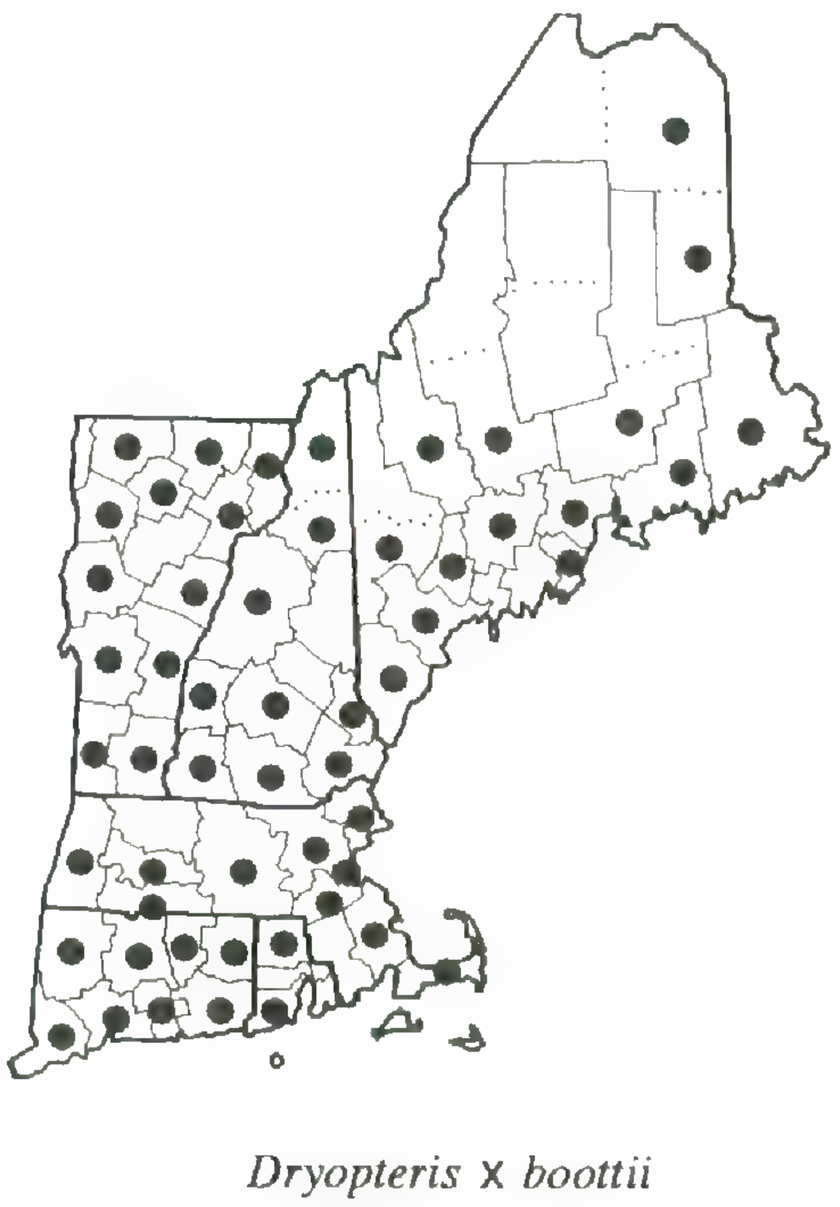
Dryopteris intermedia



Dryopteris marginalis

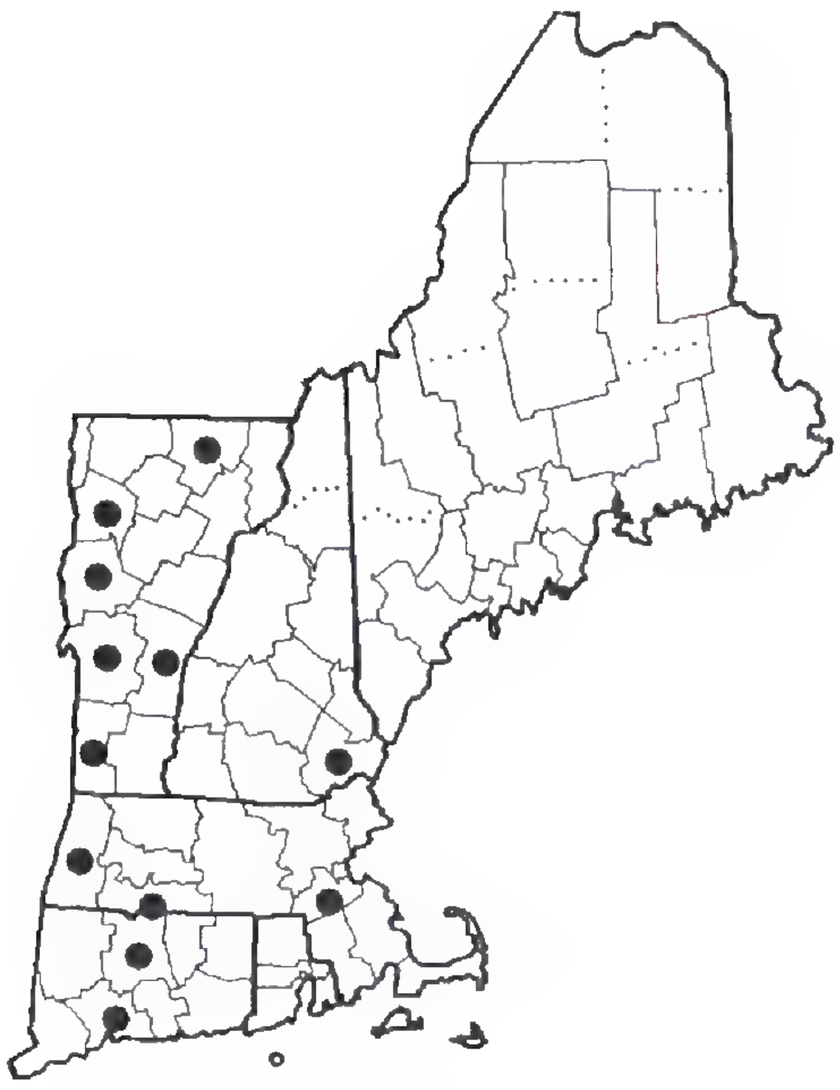


Dryopteris x *benedictii*



Dryopteris x *boottii*

Figure 22. Distribution maps for *Dryopteris intermedia*, *D. marginalis*, *D.* × *benedictii*, and *D.* × *boottii*.



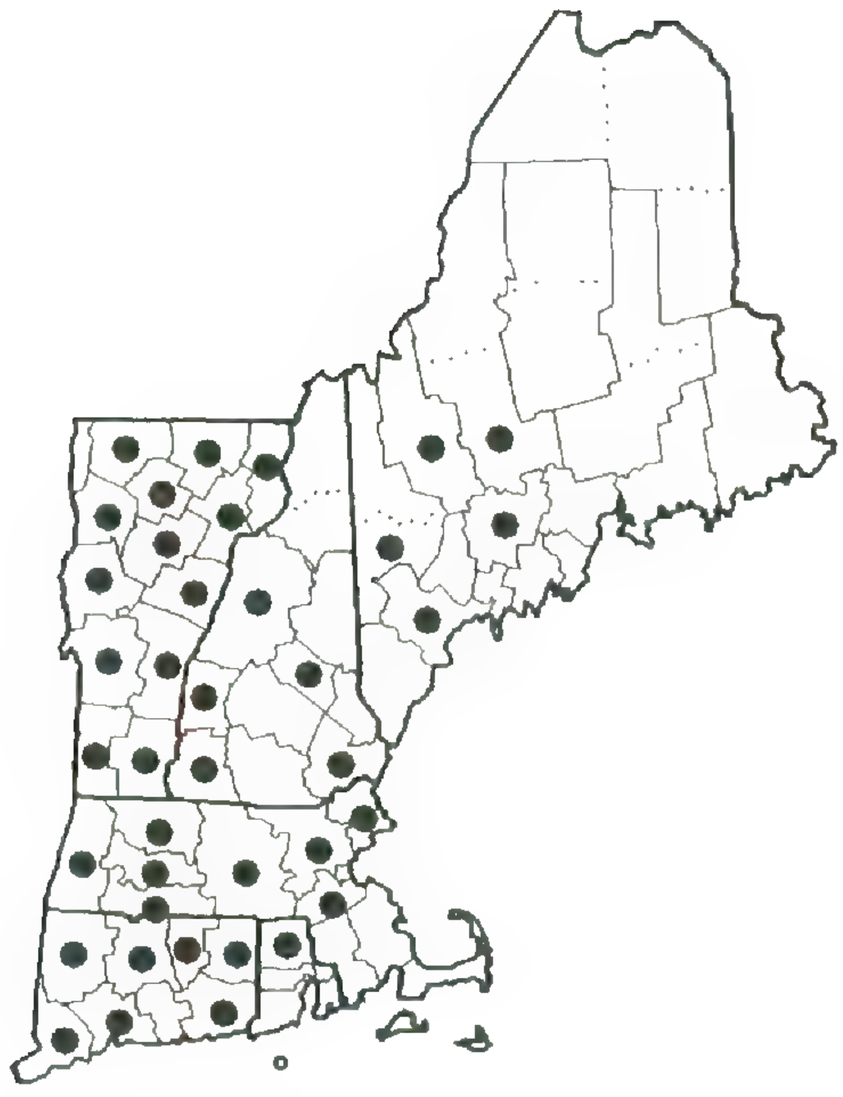
Dryopteris x *burgessii*

Dryopteris campyloptera x *D. intermedia*

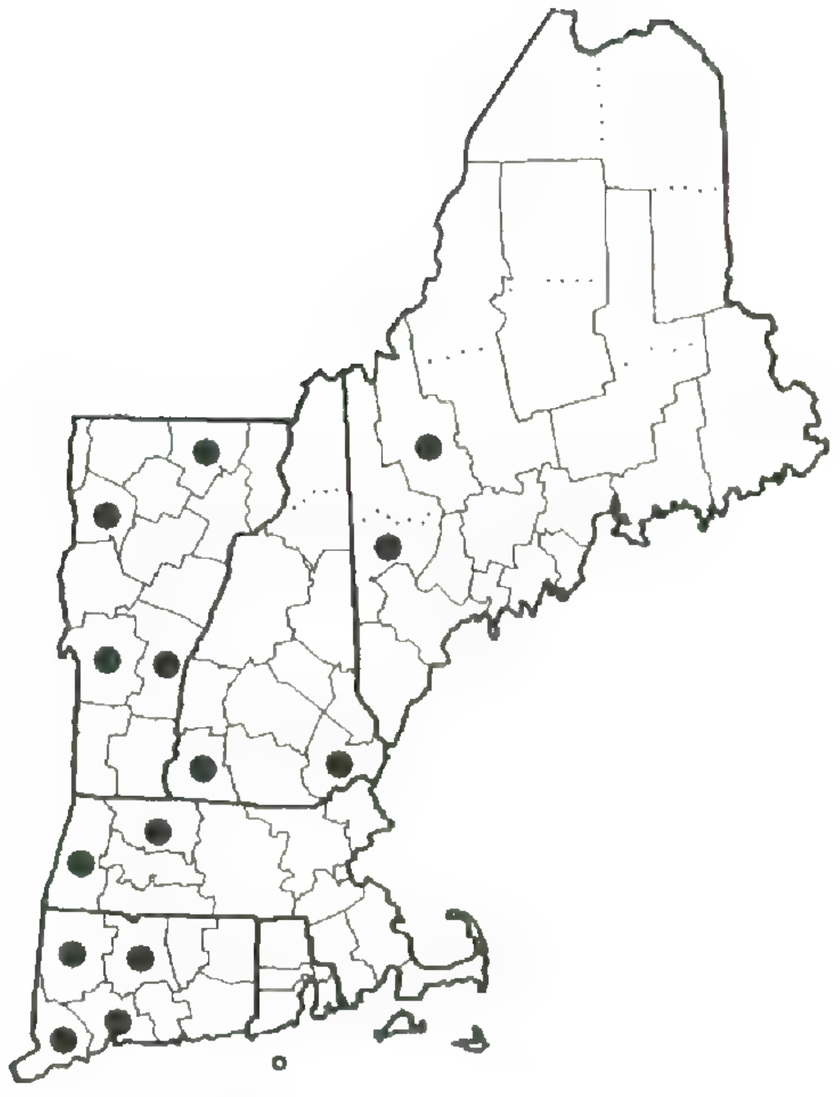
Dryopteris campyloptera x *D. marginalis*

Dryopteris carthusiana x *D. goldiana*

Figure 23. Distribution maps for *Dryopteris* × *burgessii*, *D. campyloptera* × *D. intermedia*, *D. campyloptera* × *D. marginalis*, and *D. carthusiana* × *D. goldiana*.

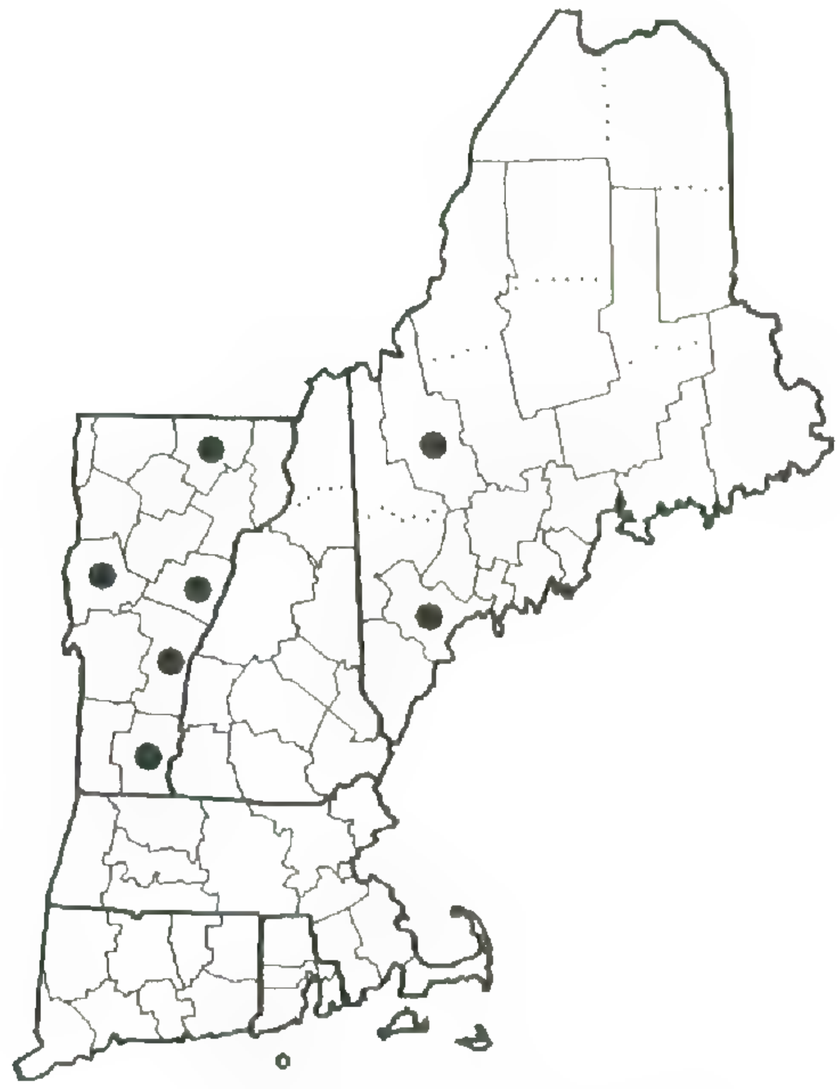


Dryopteris x *clintoniana*



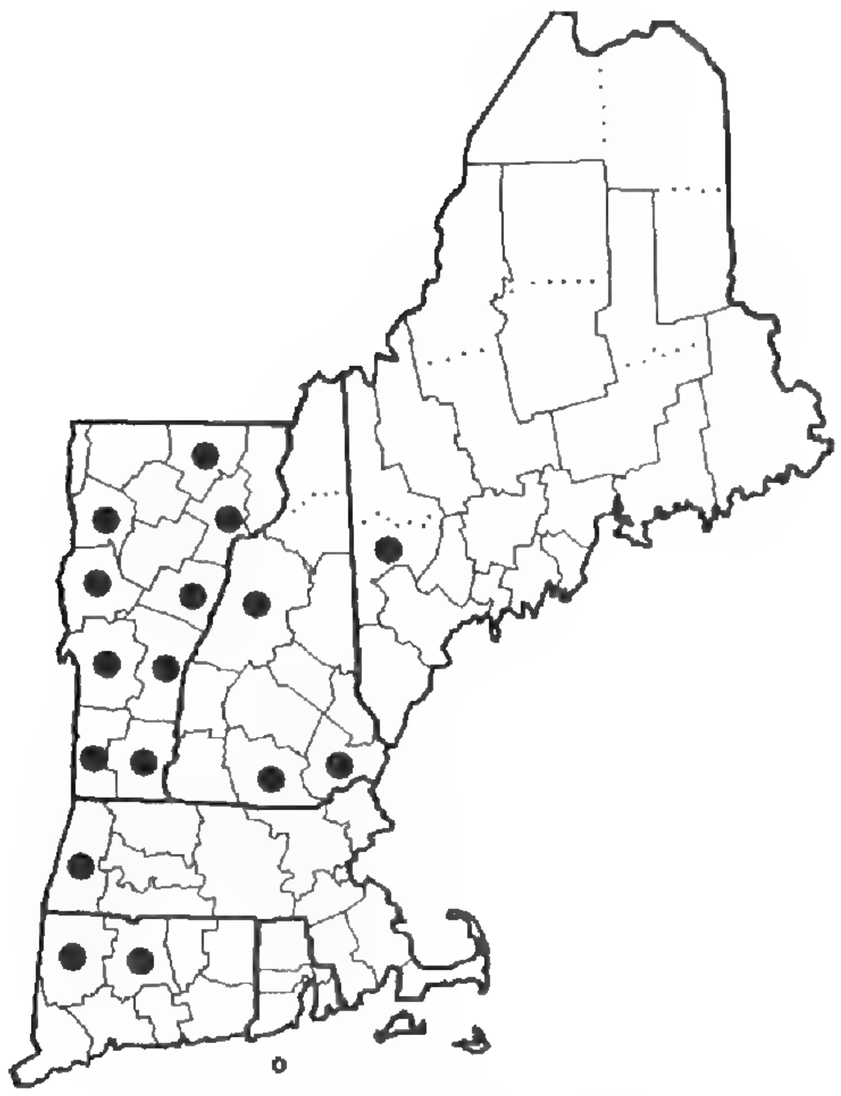
Dryopteris x *clintoniana* x *D. cristata*

Dryopteris x *clintoniana* x *D. filix-mas*

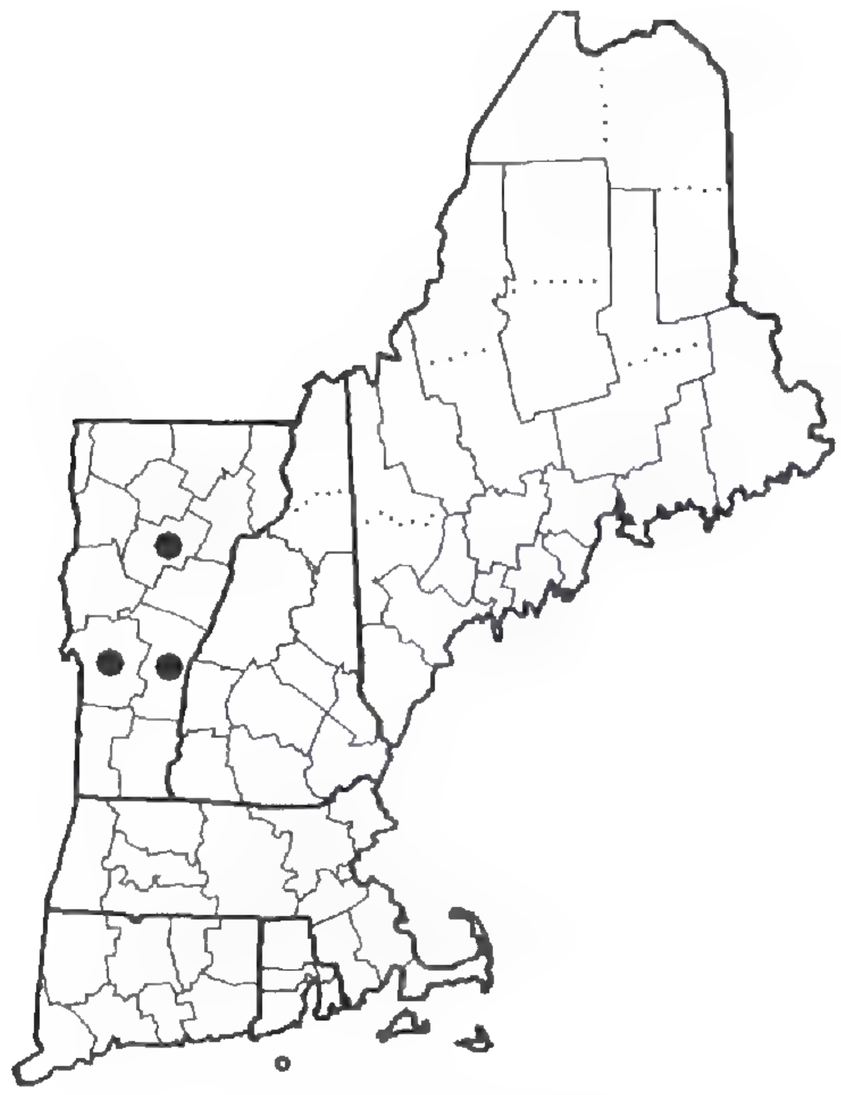


Dryopteris x *clintoniana* x *D. goldiana*

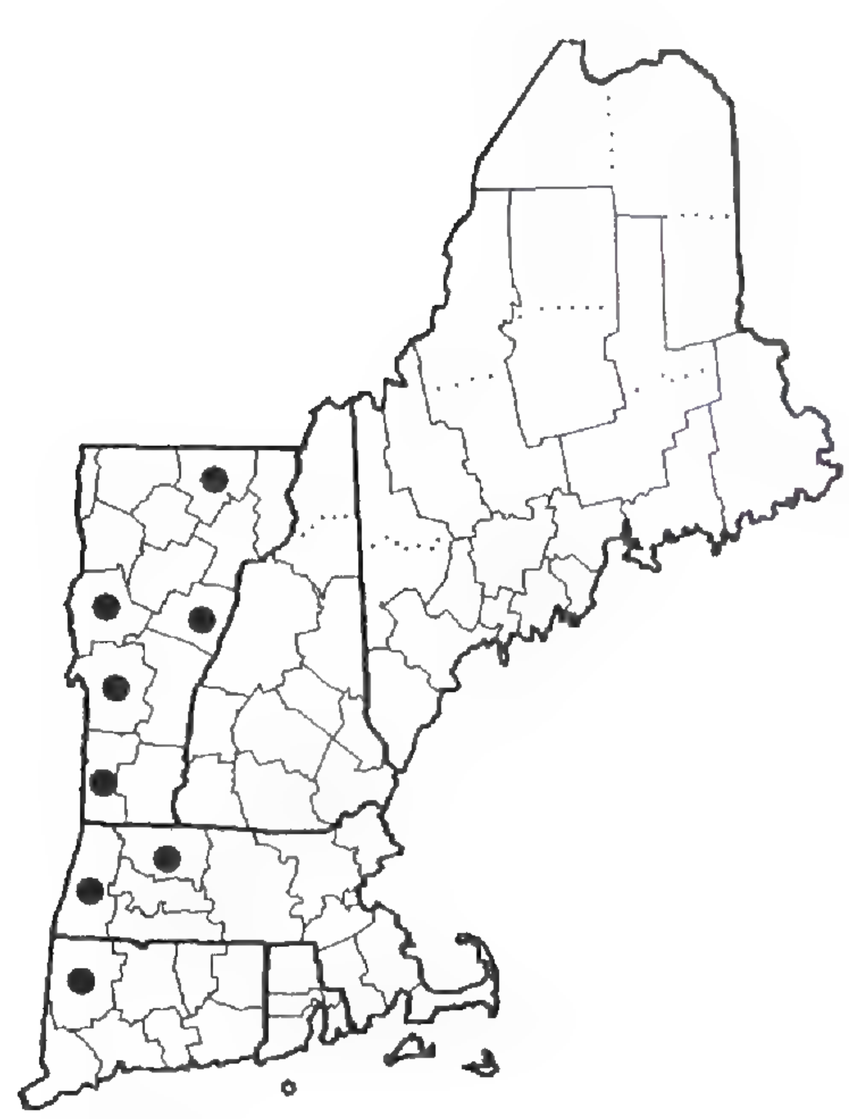
Figure 24. Distribution maps for *Dryopteris* × *clintoniana*, *D.* × *clintoniana* × *D. cristata*, *D.* × *clintoniana* × *D. filix-mas*, and *D.* × *clintoniana* × *D. goldiana*.



Dryopteris x *dowellii*



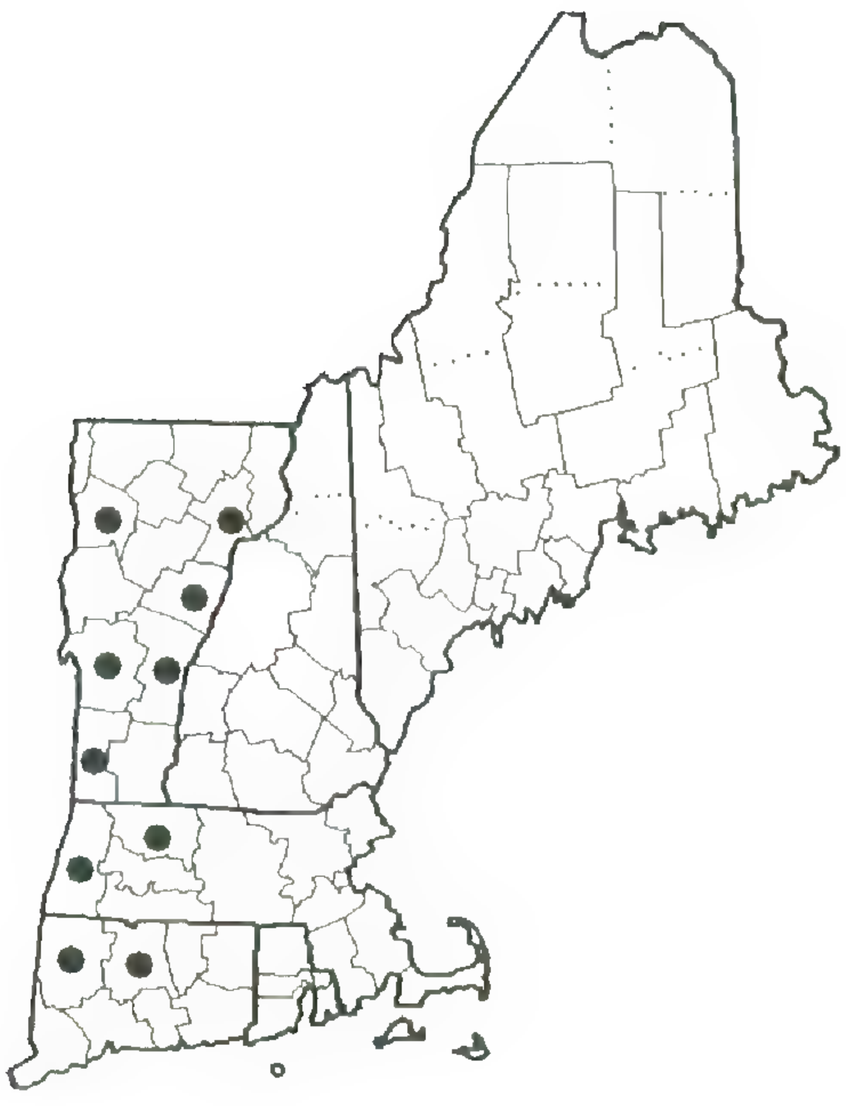
Dryopteris filix-mas x *D. marginalis*



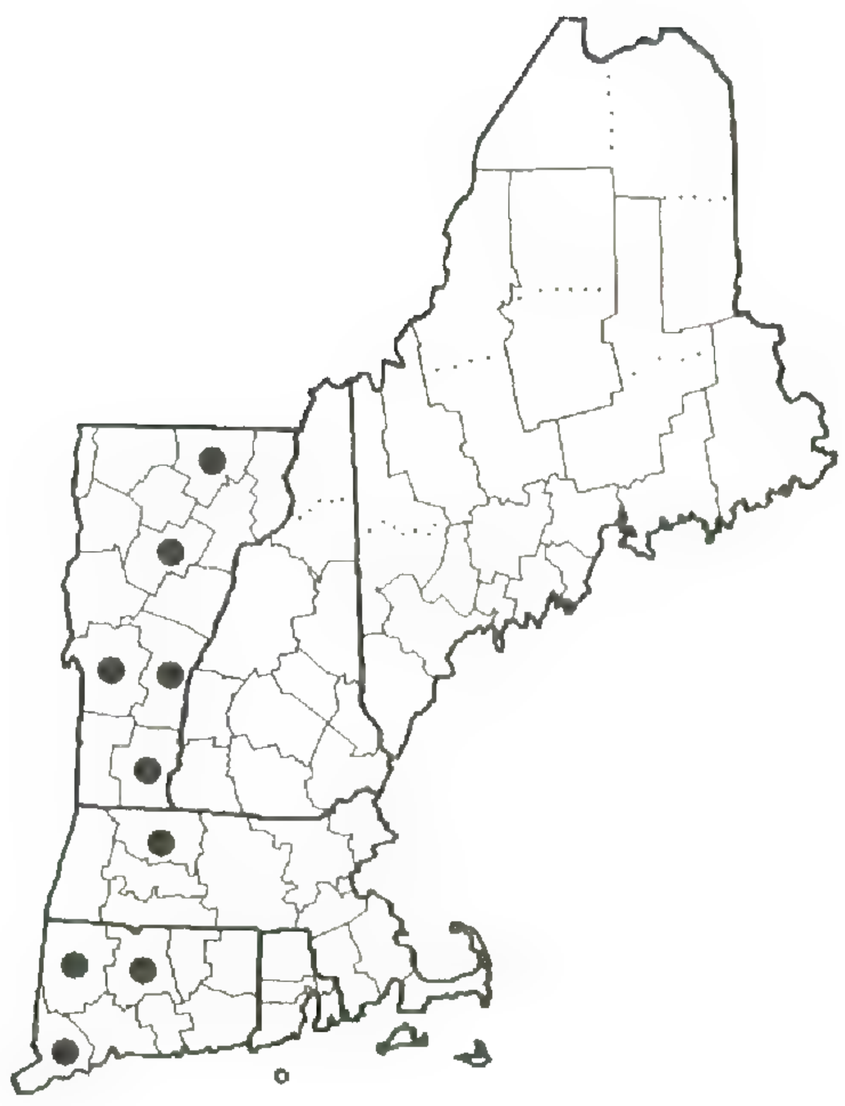
Dryopteris goldiana x *D. intermedia*

Dryopteris intermedia x *D. marginalis*

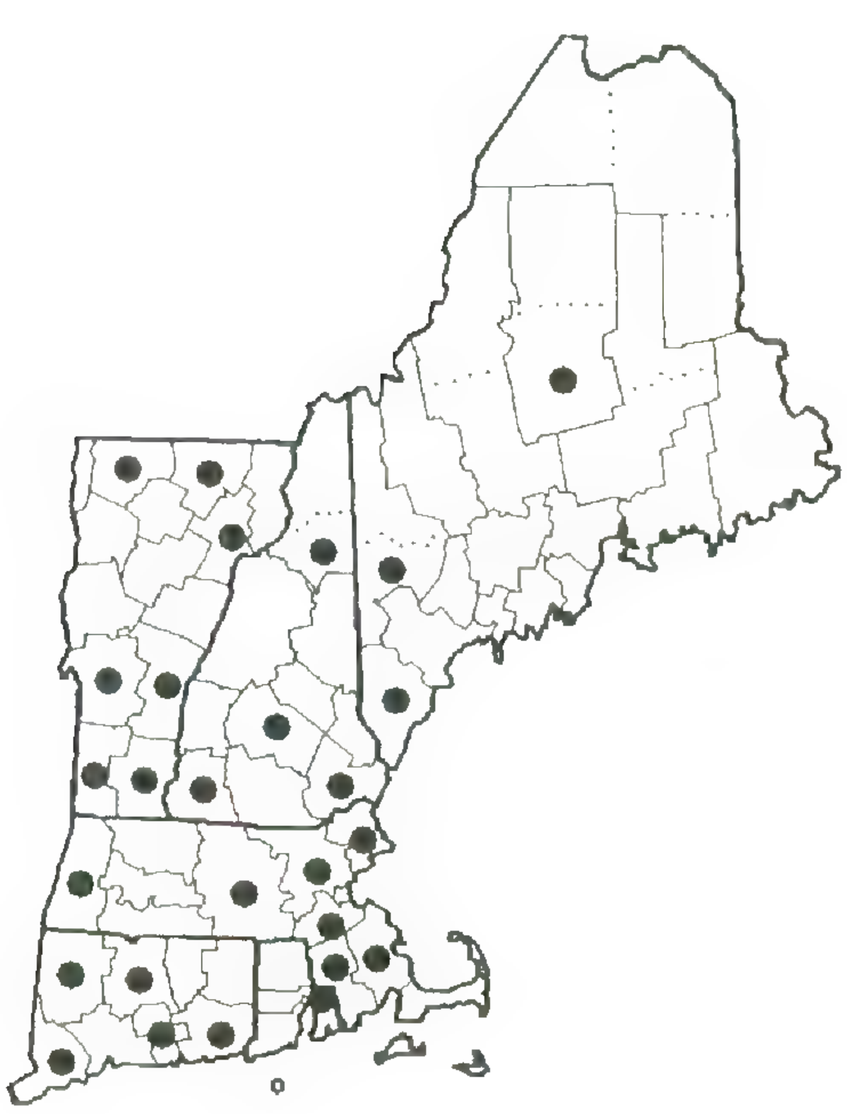
Figure 25. Distribution maps for *Dryopteris* × *dowellii*, *D. filix-mas* × *D. marginalis*, *D. goldiana* × *D. intermedia*, and *D. intermedia* × *D. marginalis*.



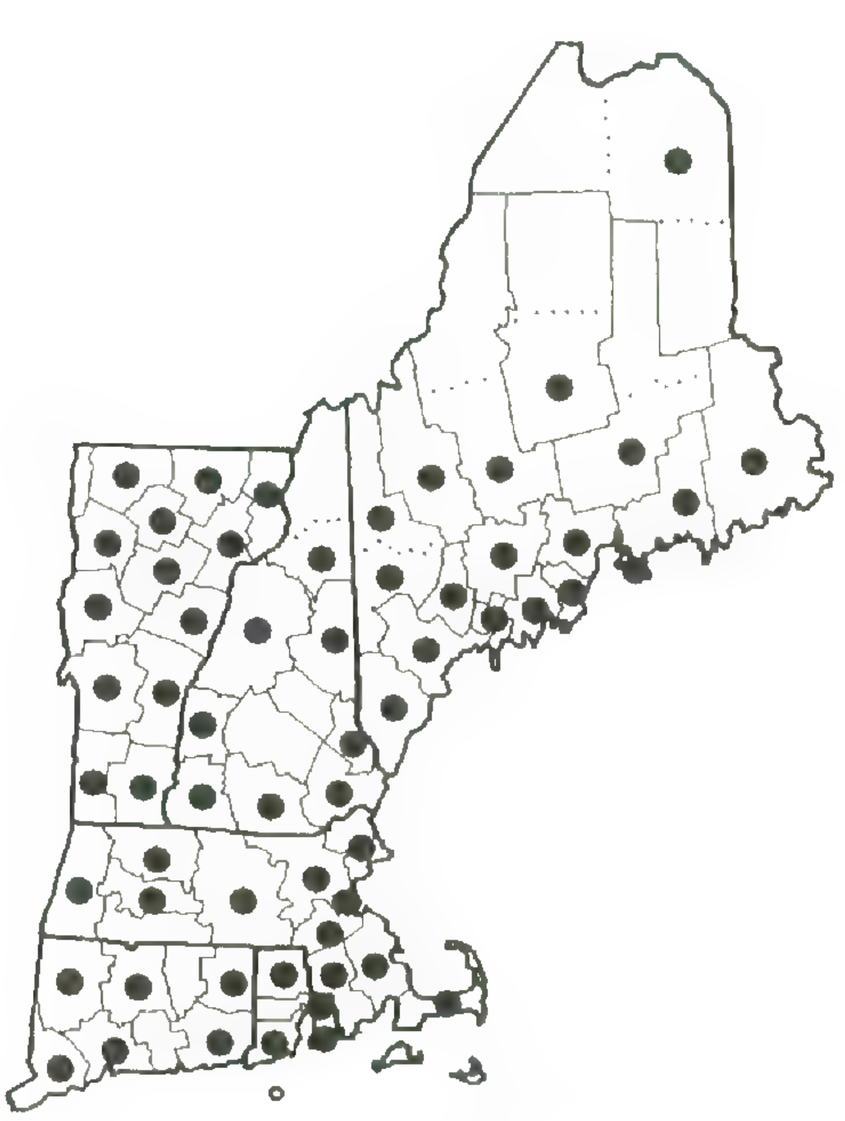
Dryopteris x *neowherryi*



Dryopteris x *pittsfordensis*

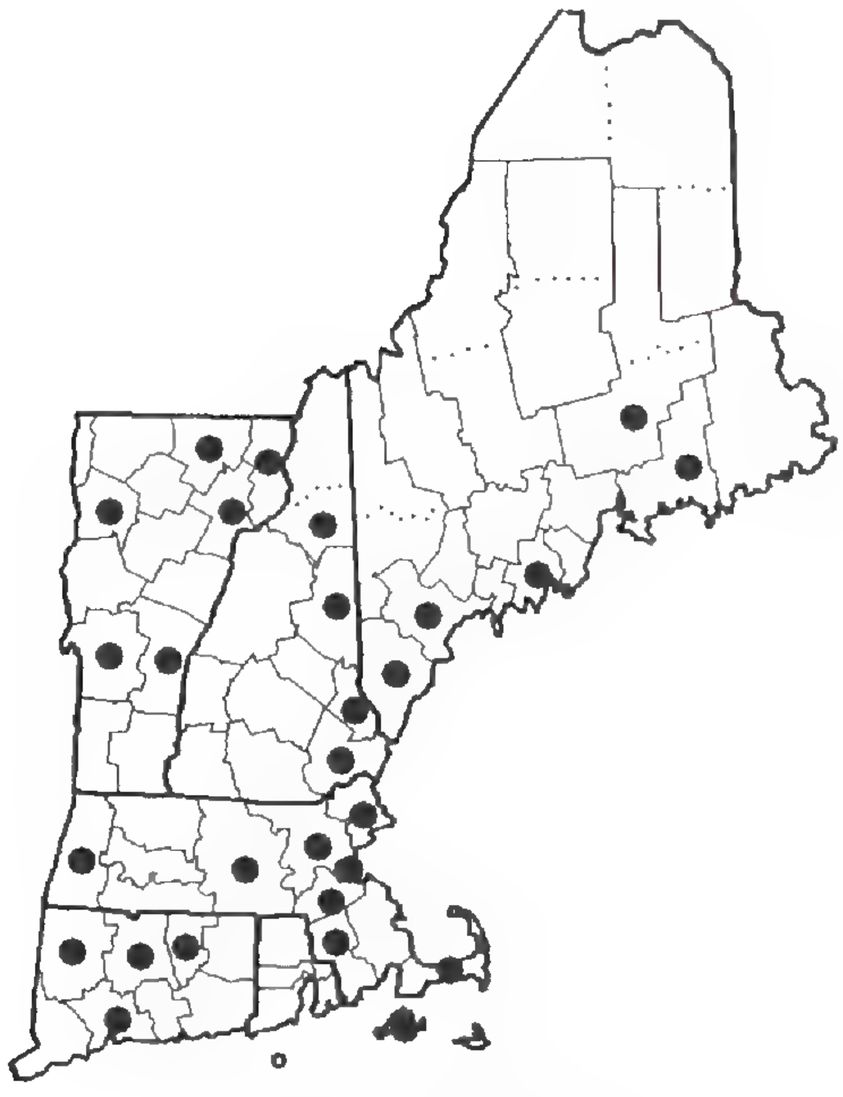


Dryopteris x *slossoniae*

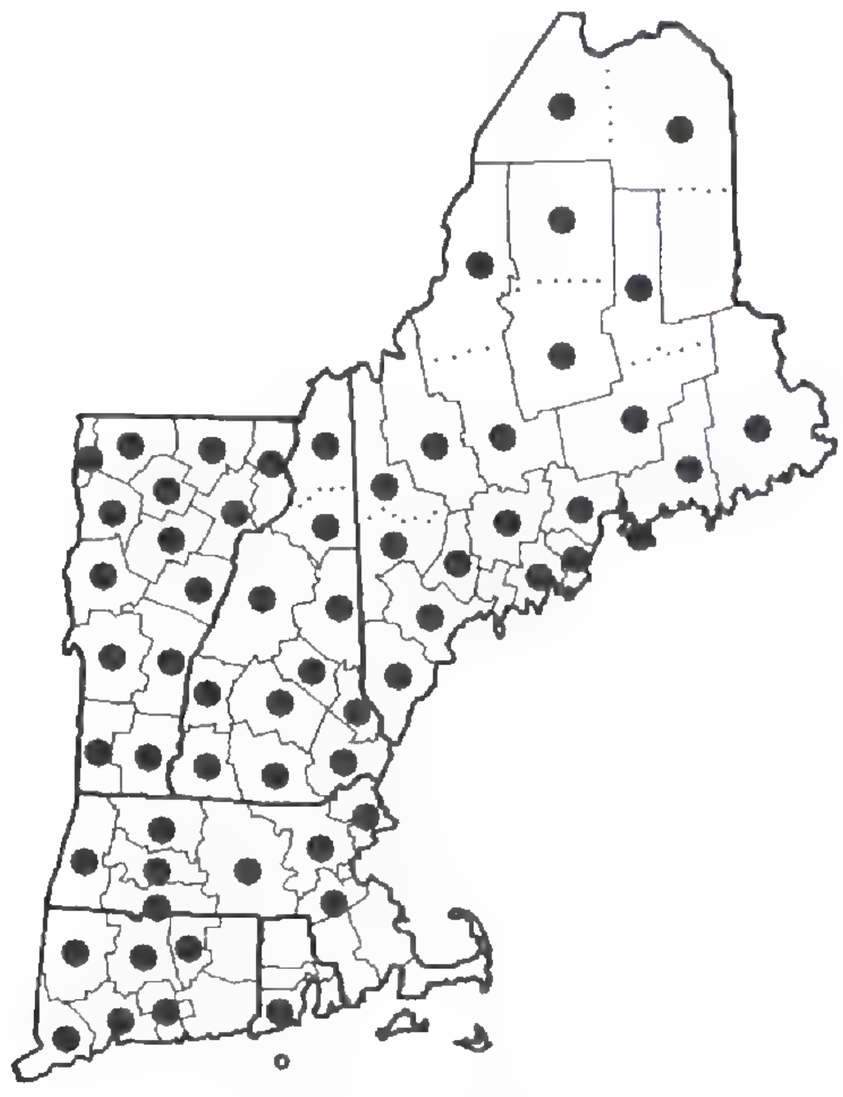


Dryopteris x *triploidea*

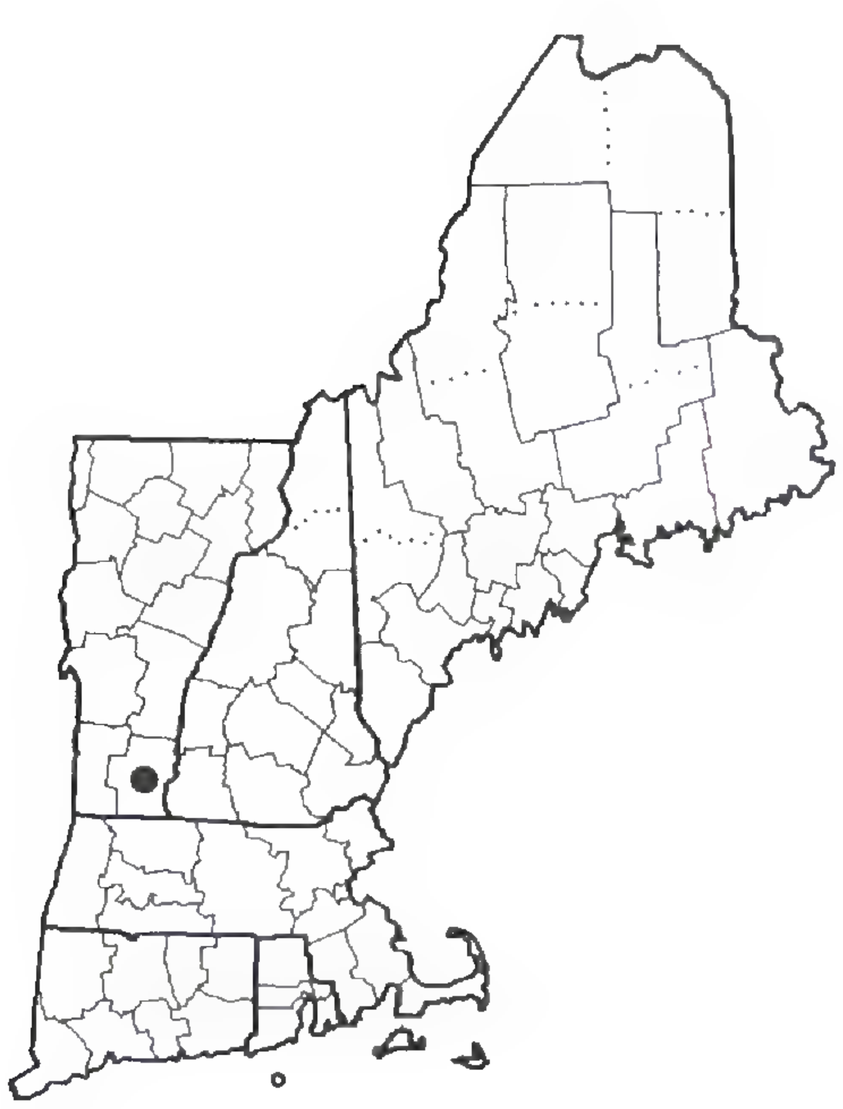
Figure 26. Distribution maps for *Dryopteris* × *neowherryi*, *D.* × *pittsfordensis*, *D.* × *slossoniae*, and *D.* × *triploidea*.



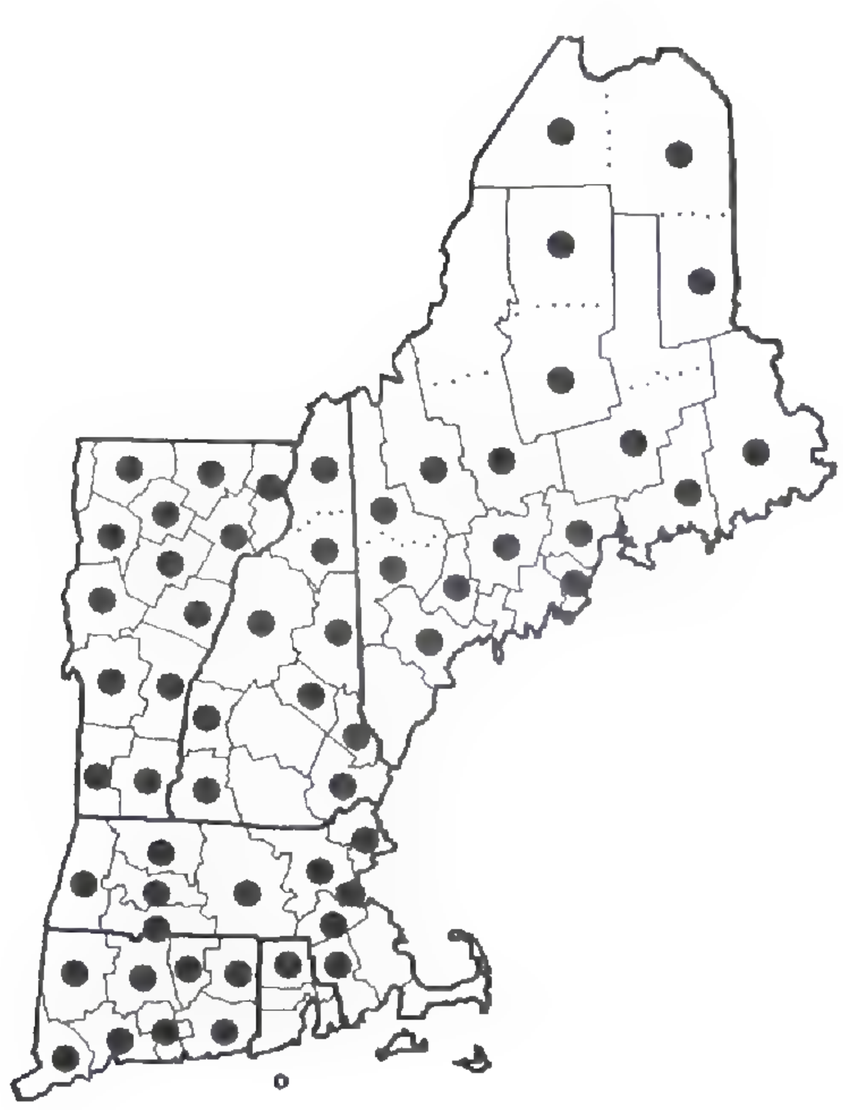
Dryopteris x *uliginosa*



Gymnocarpium dryopteris

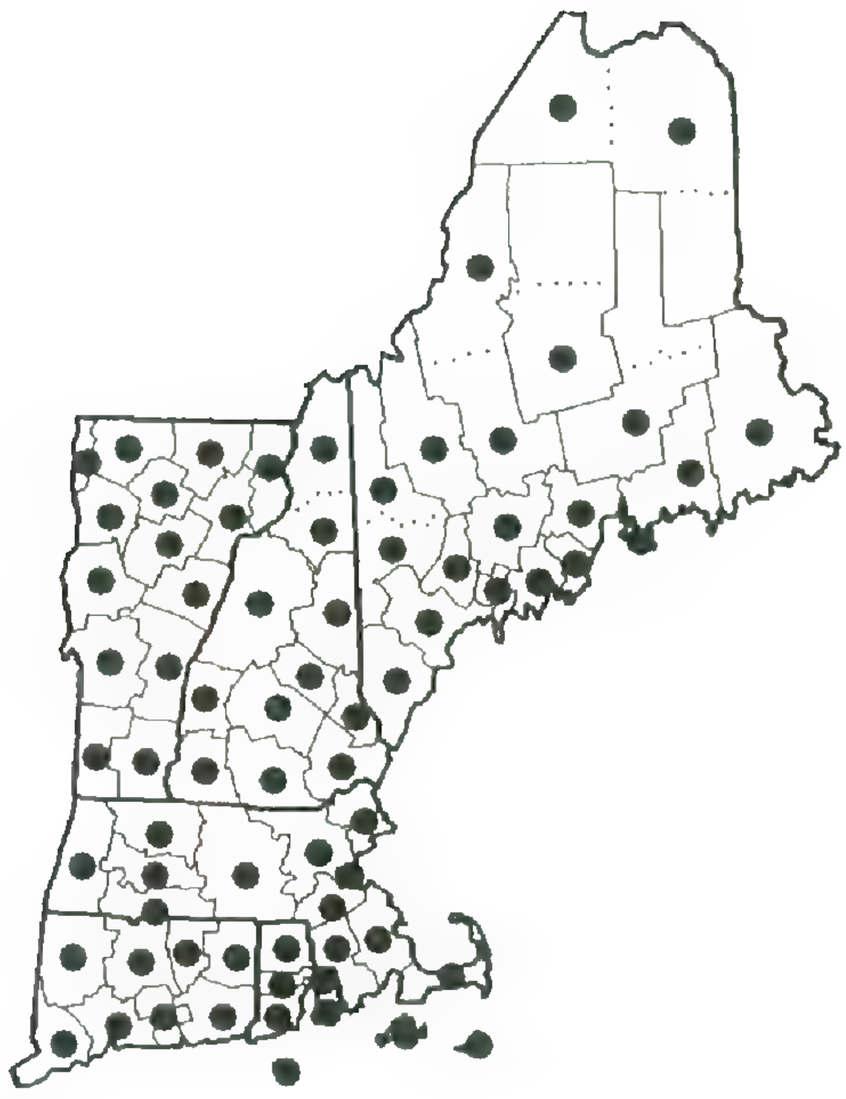


Gymnocarpium jessoense
subsp. *parvulum*

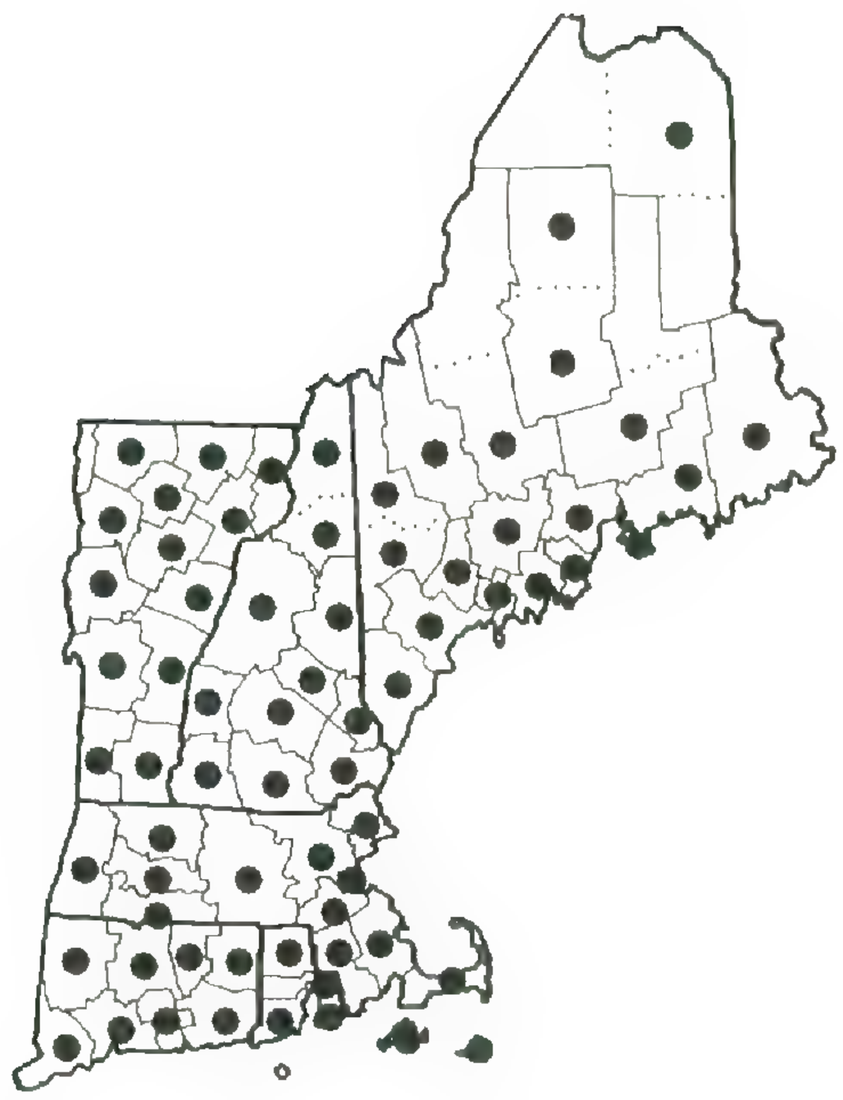


Matteuccia struthiopteris

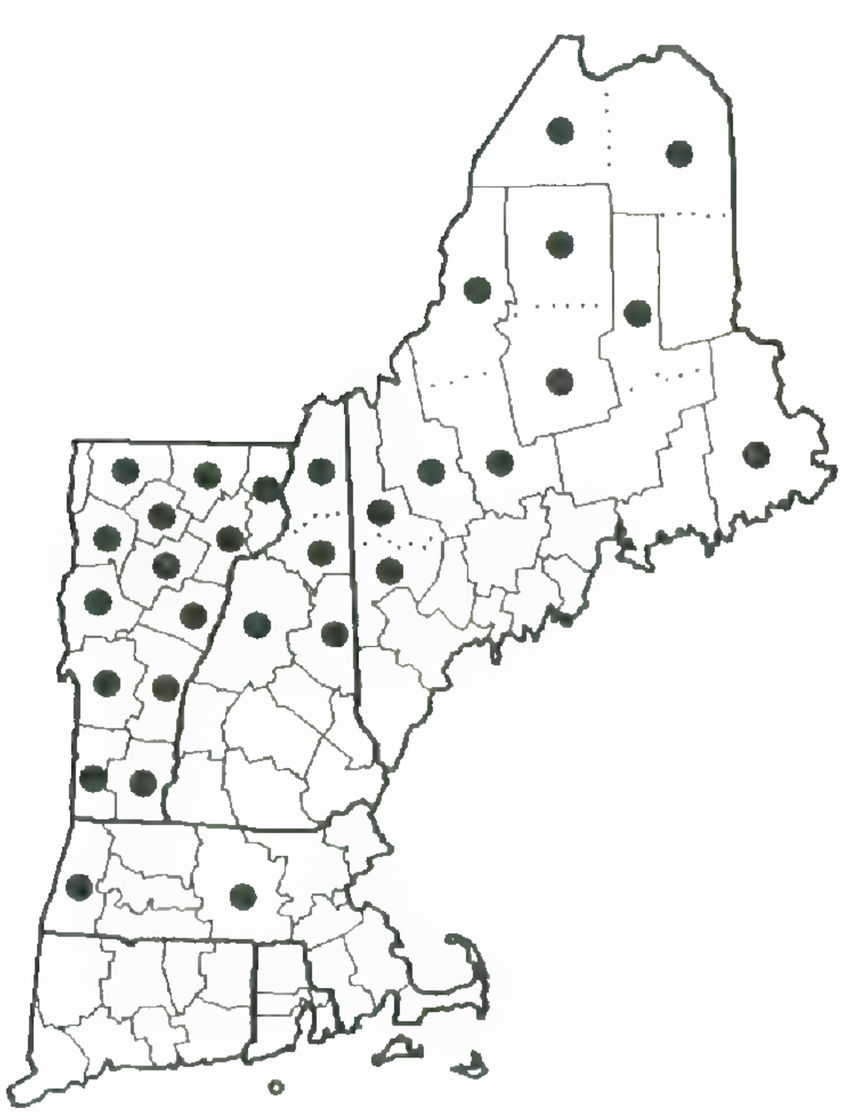
Figure 27. Distribution maps for *Dryopteris* × *uliginosa*, *Gymnocarpium dryopteris*, *G. jessoense* subsp. *parvulum*, and *Matteuccia struthiopteris*.



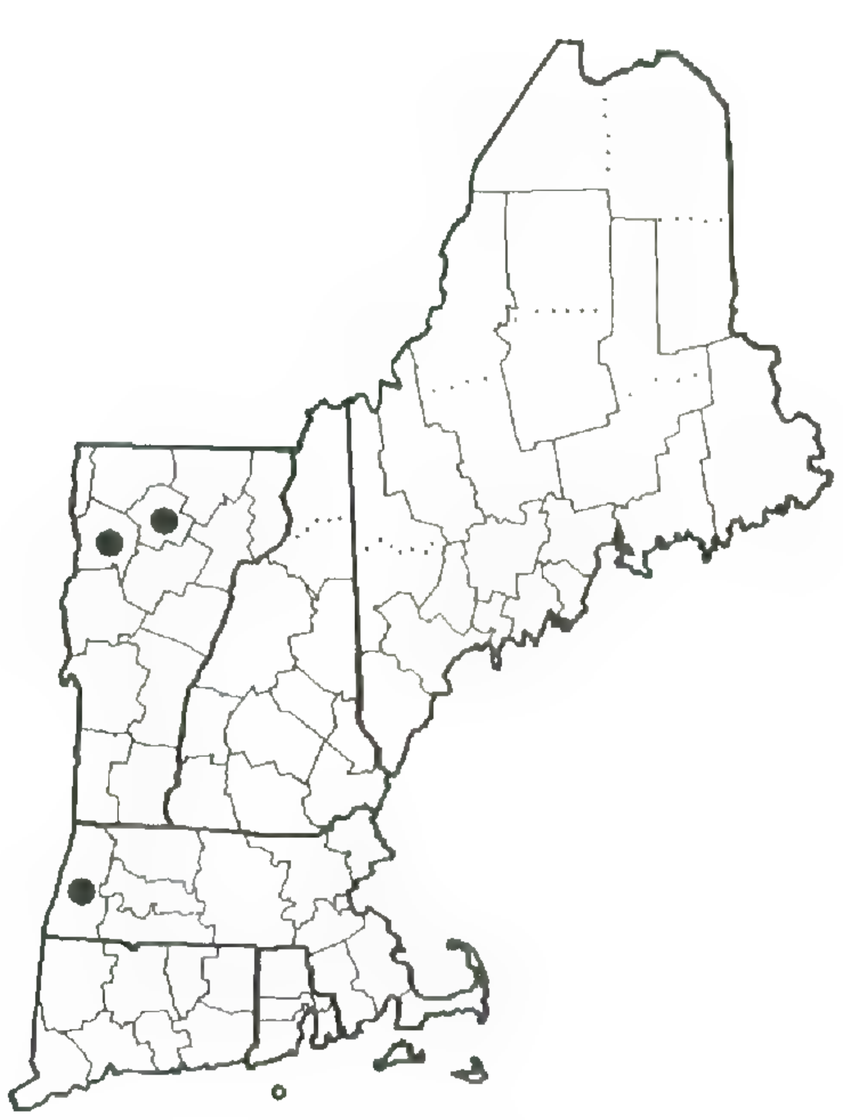
Onoclea sensibilis



Polystichum acrostichoides

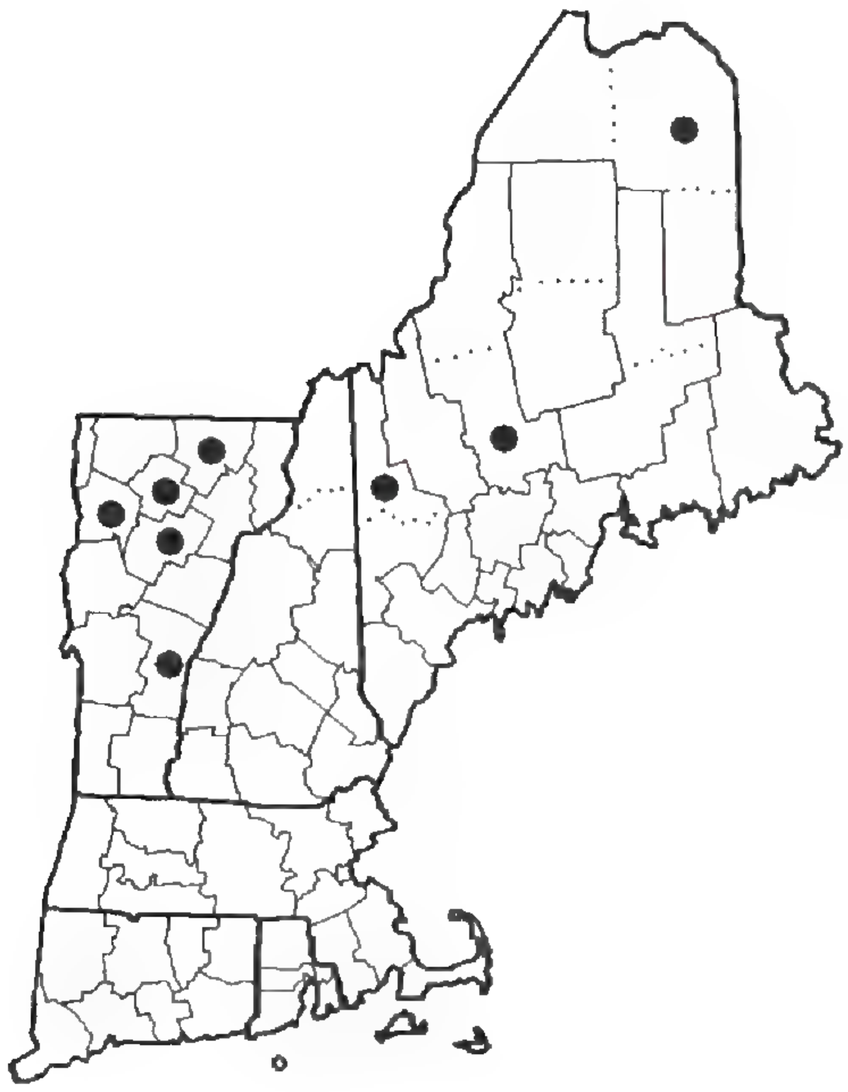


Polystichum braunii

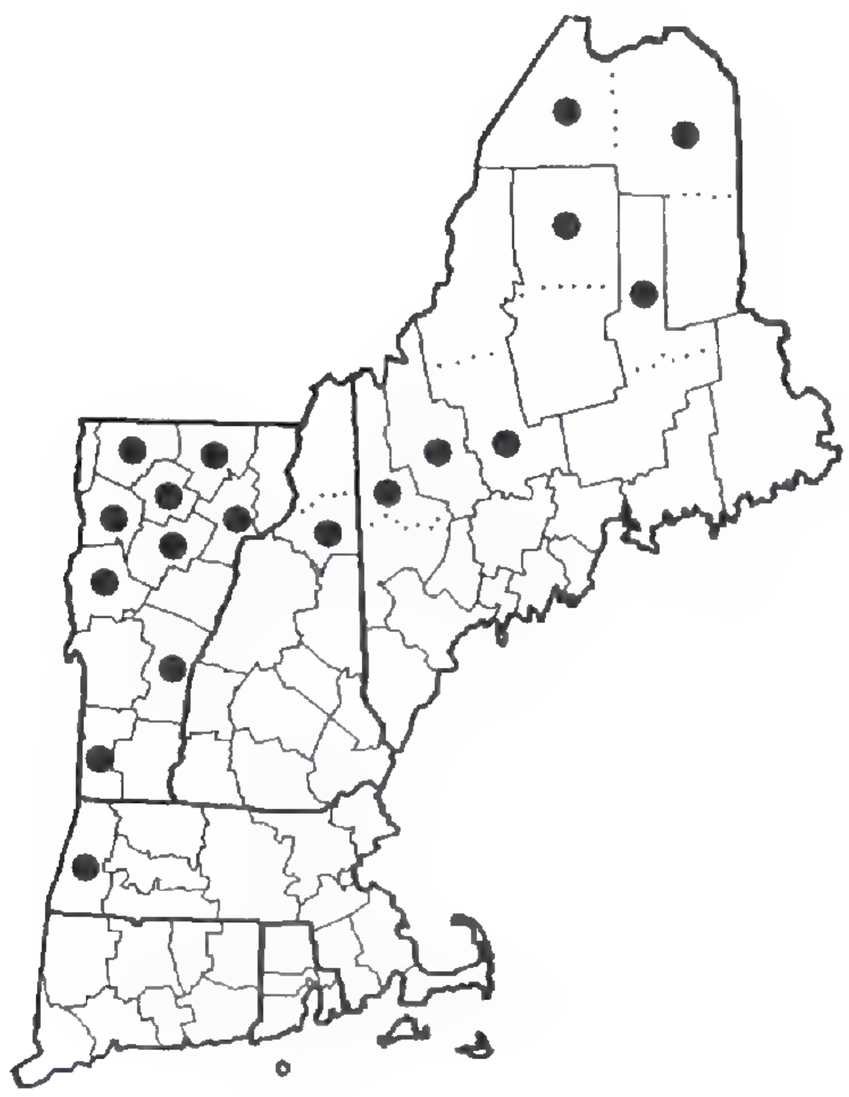


Polystichum x potteri

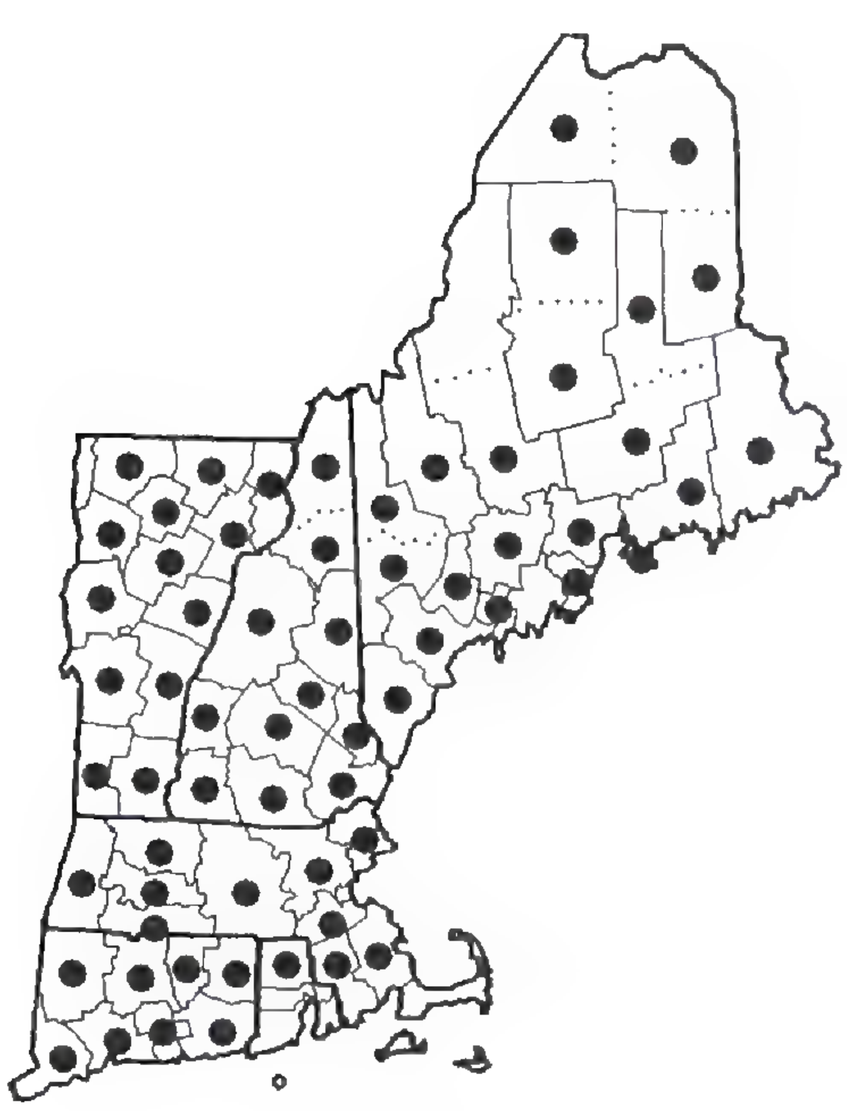
Figure 28. Distribution maps for *Onoclea sensibilis*, *Polystichum acrostichoides*, *P. braunii*, and *P.* × *potteri*.



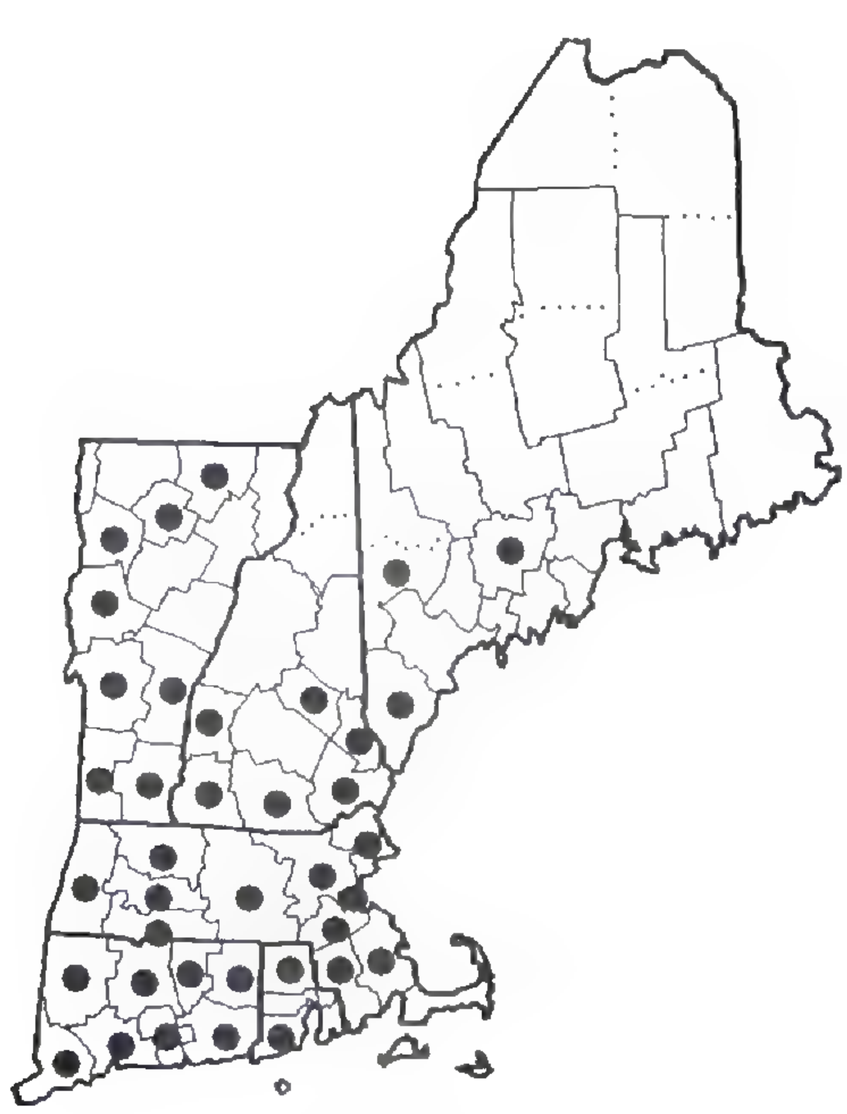
Woodsia alpina



Woodsia glabella

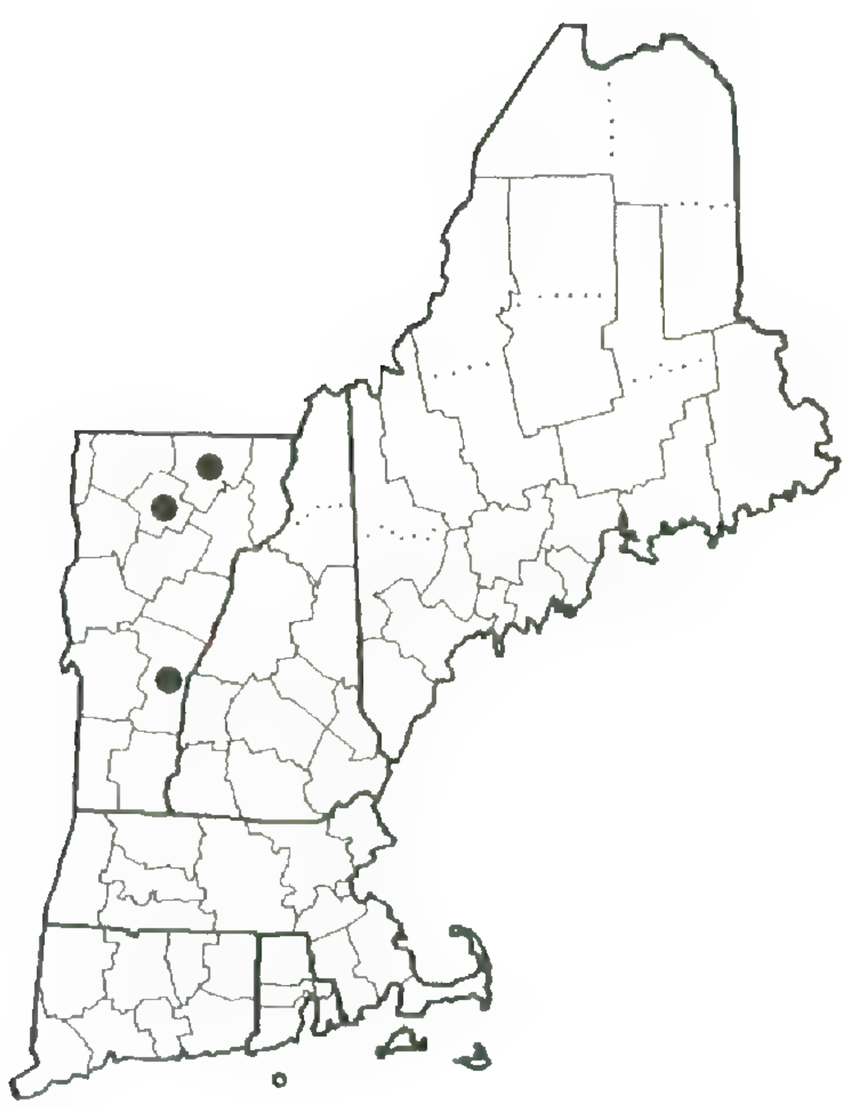


Woodsia ilvensis

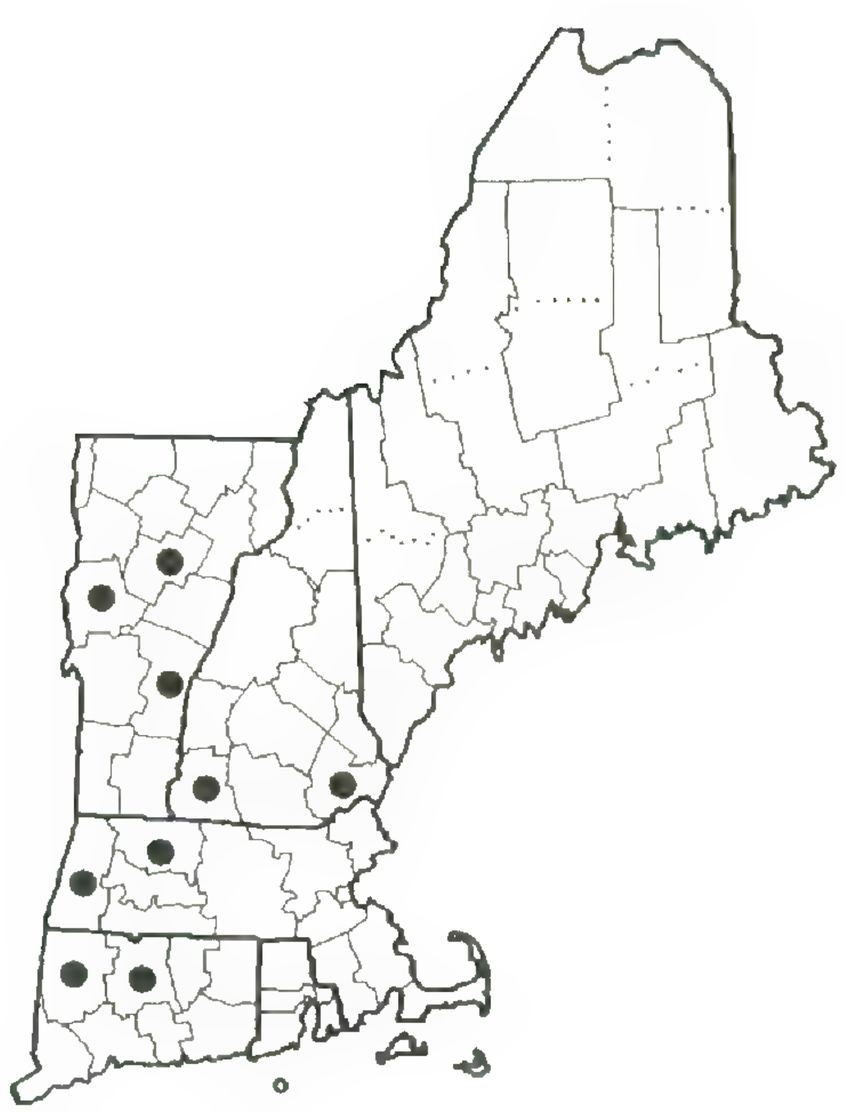


Woodsia obtusa

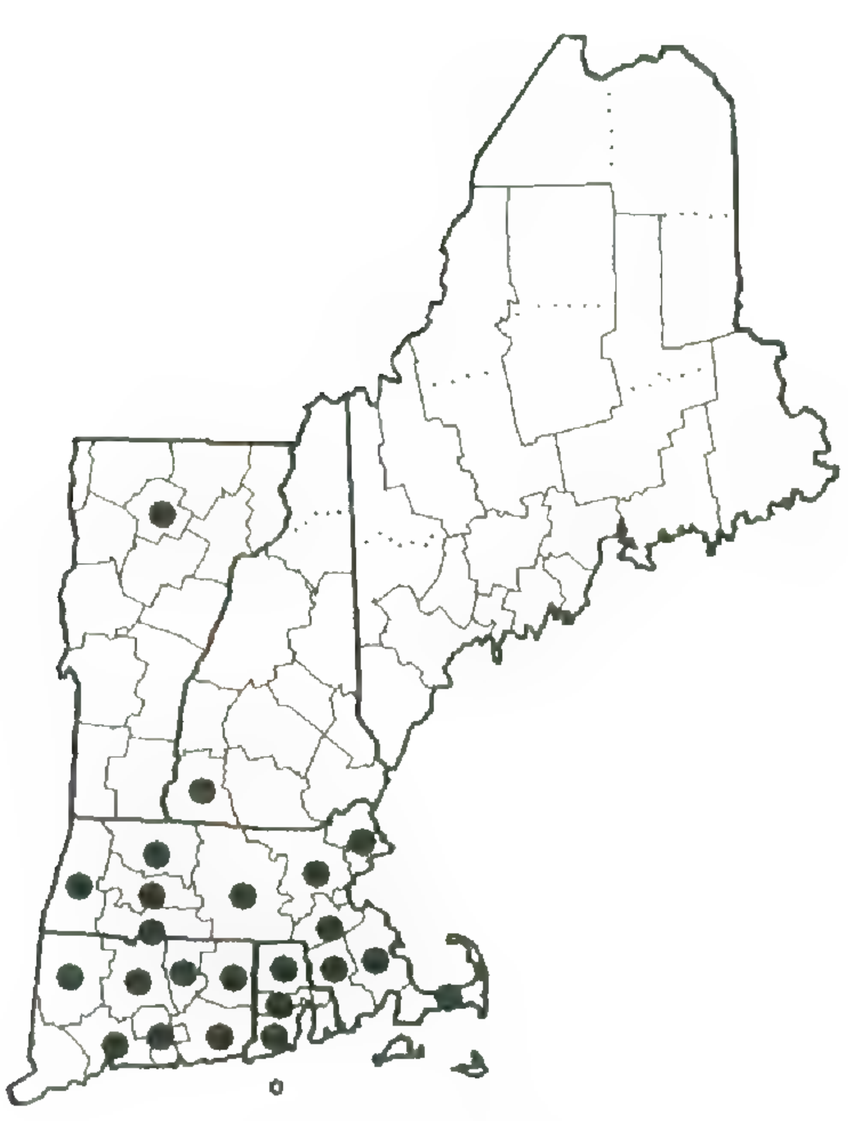
Figure 29. Distribution maps for *Woodsia alpina*, *W. glabella*, *W. ilvensis*, and *W. obtusa*.



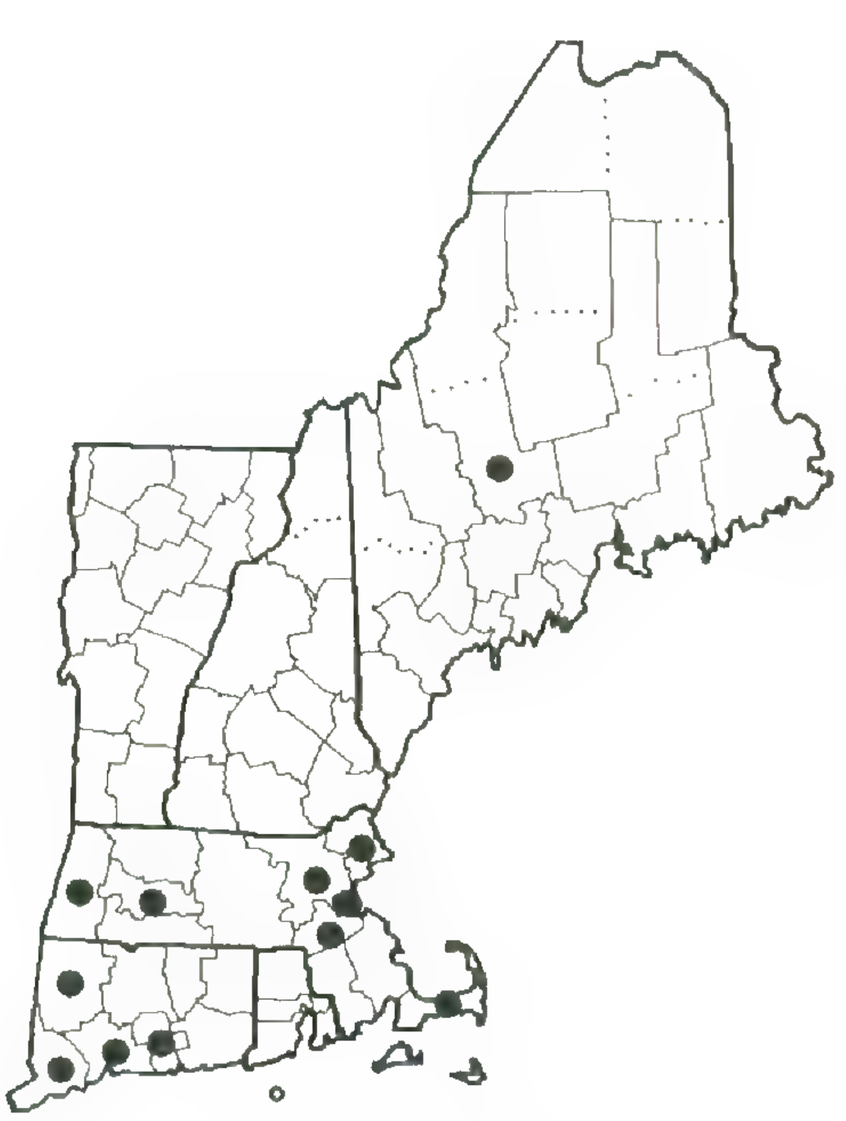
Woodsia x *gracilis*



Trichomanes intricatum

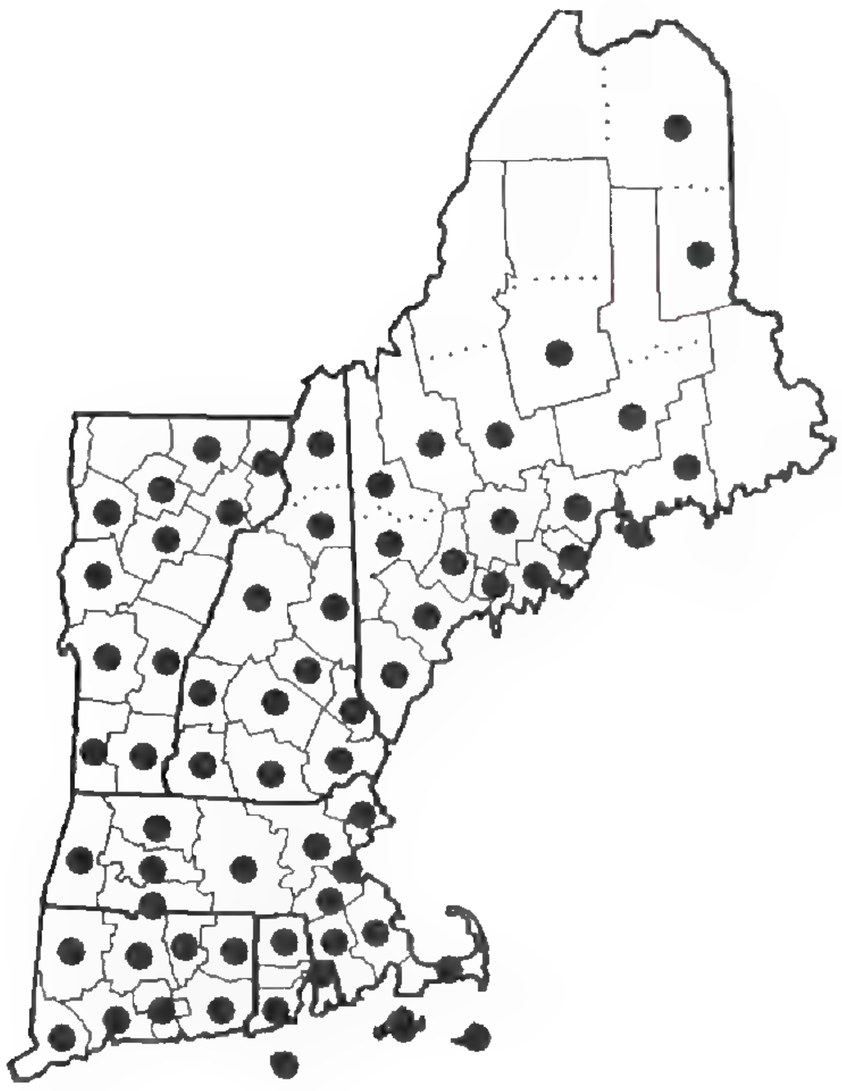


Lygodium palmatum

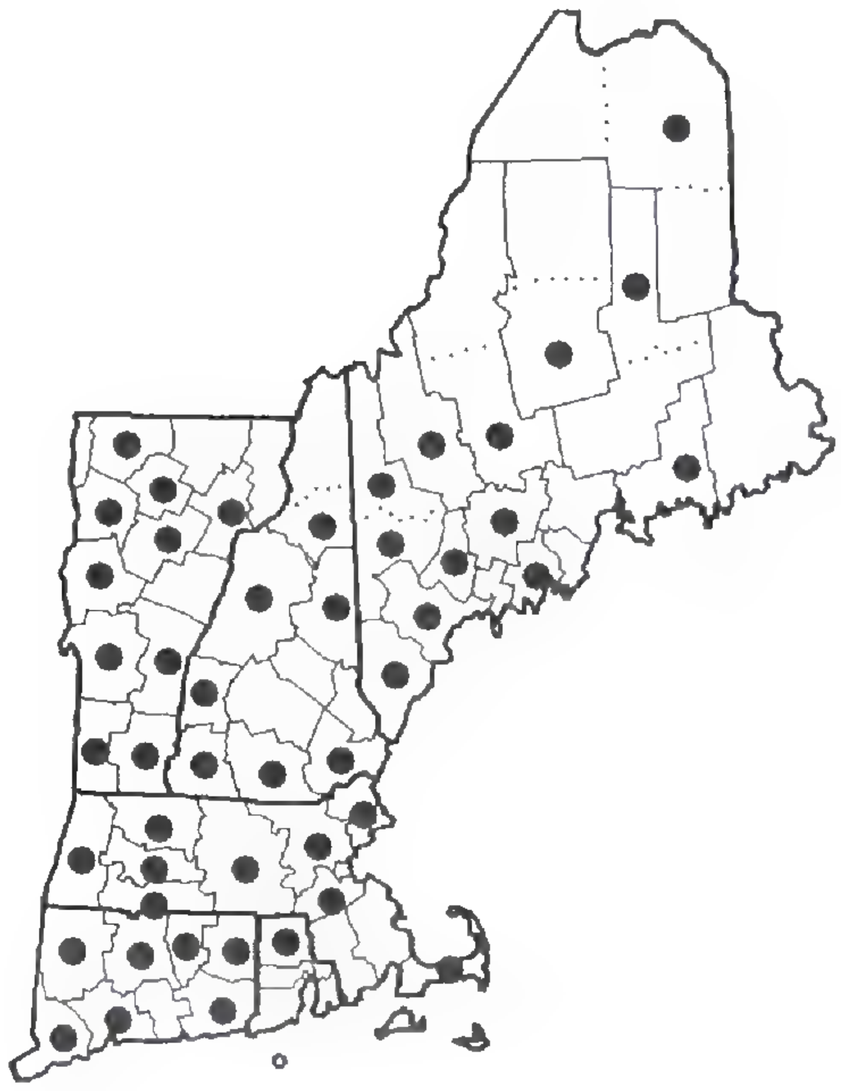


MARSILEA QUADRIFOLIA

Figure 30. Distribution maps for *Woodsia* × *gracilis*, *Trichomanes intricatum*, *Lygodium palmatum*, and *MARSILEA QUADRIFOLIA*.

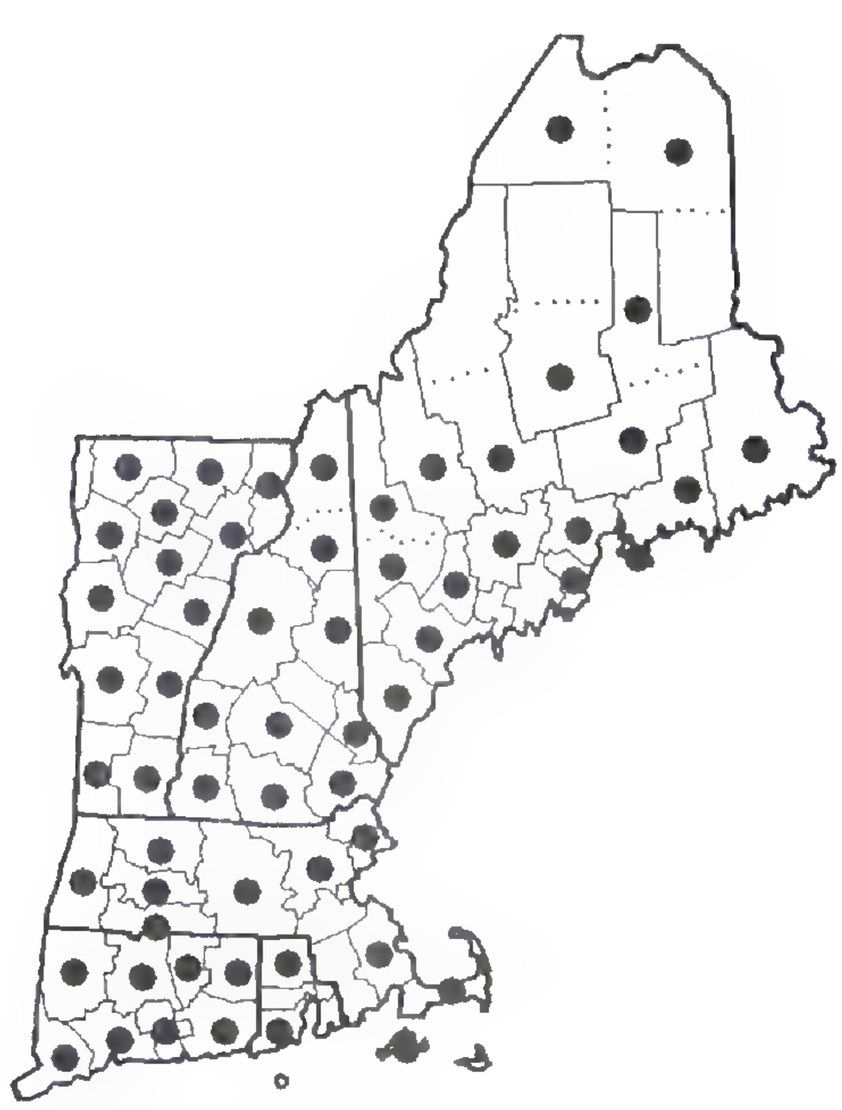


Botrychium dissectum



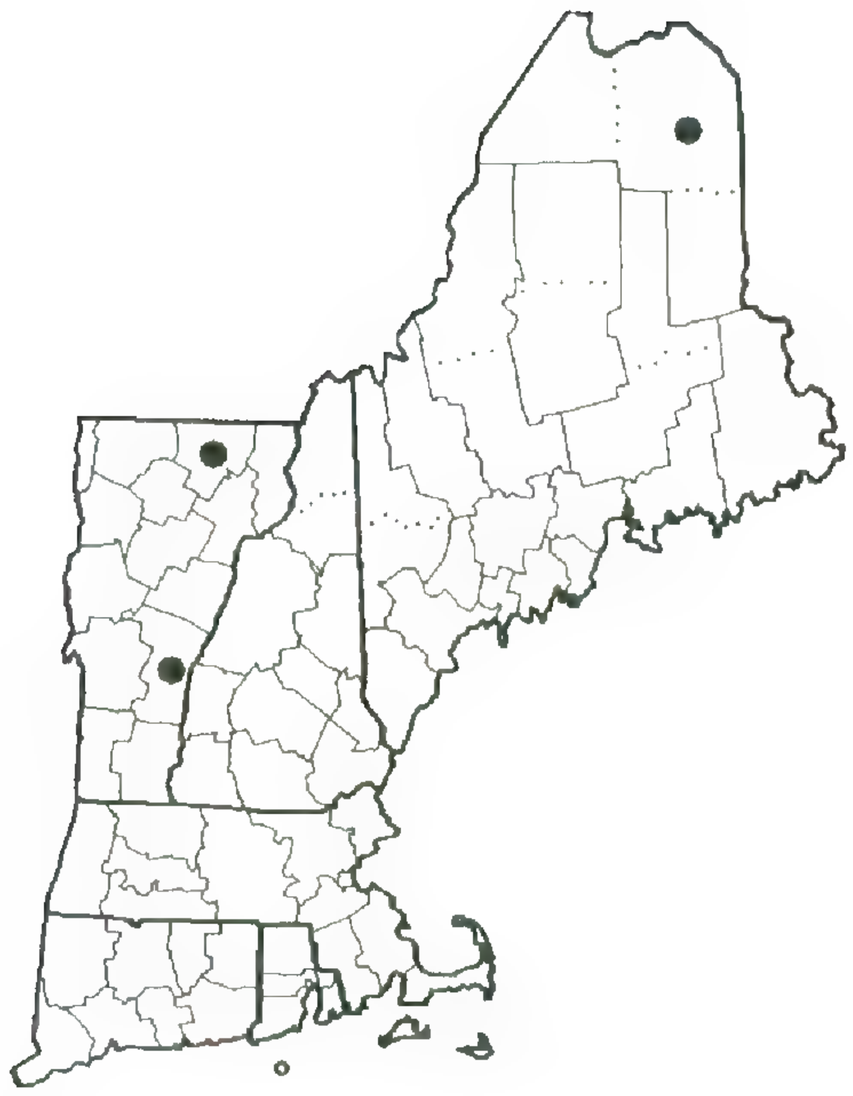
Botrychium lanceolatum subsp. *angustisegmentum*

Botrychium lunaria

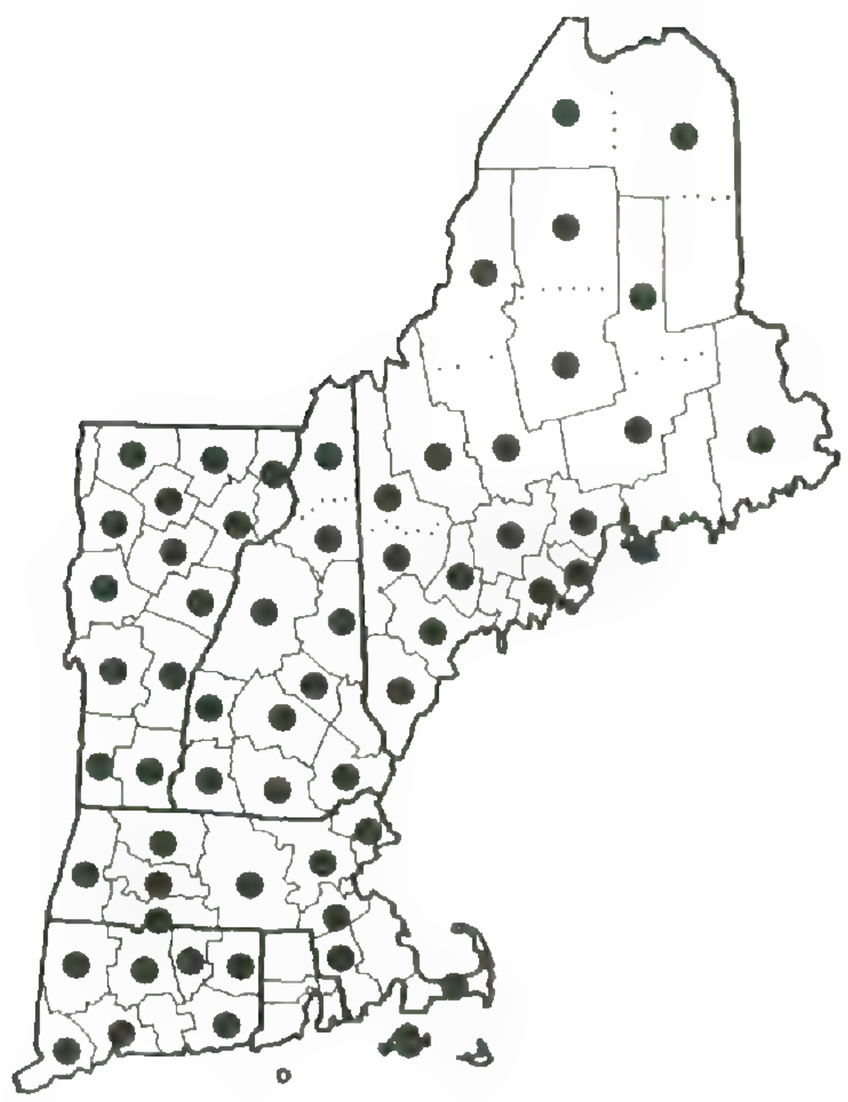


Botrychium matricariifolium

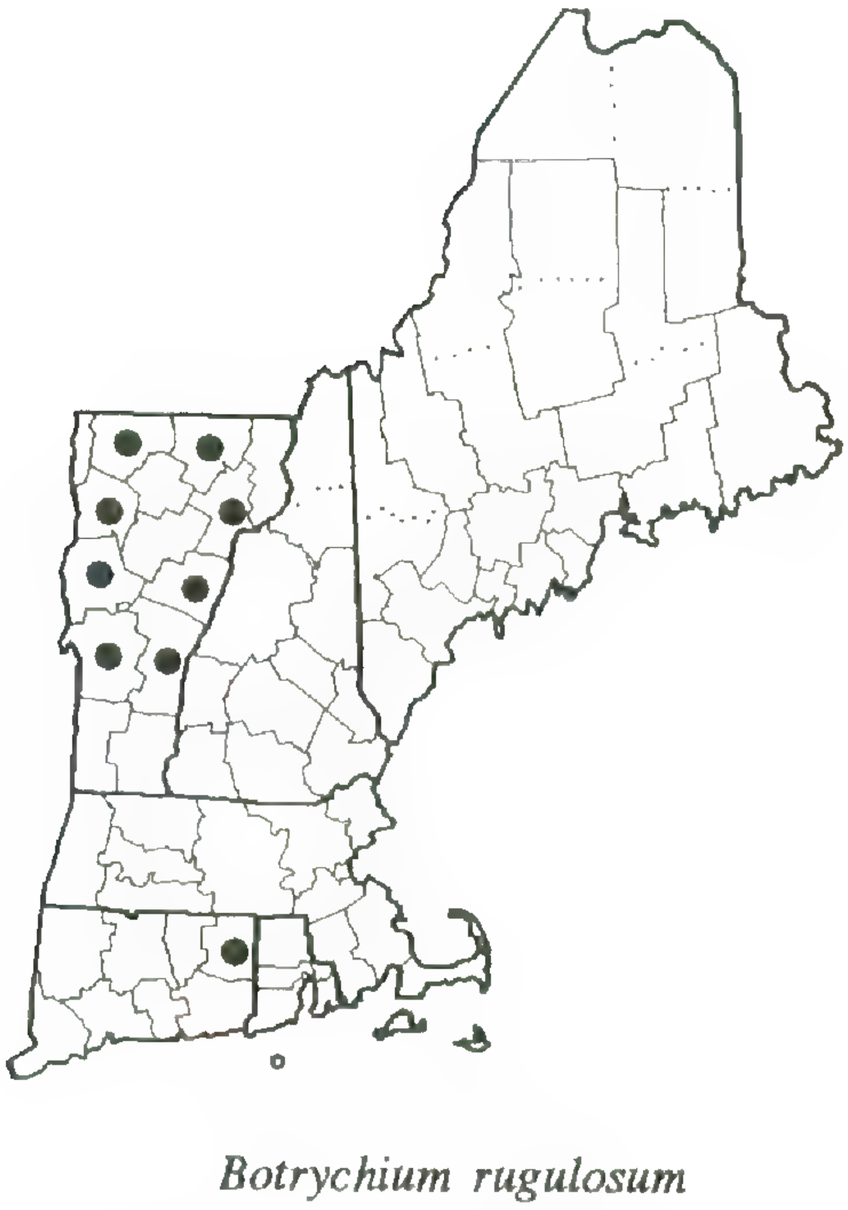
Figure 31. Distribution maps for *Botrychium dissectum*, *B. lanceolatum* subsp. *angustisegmentum*, *B. lunaria*, and *B. matricariifolium*.



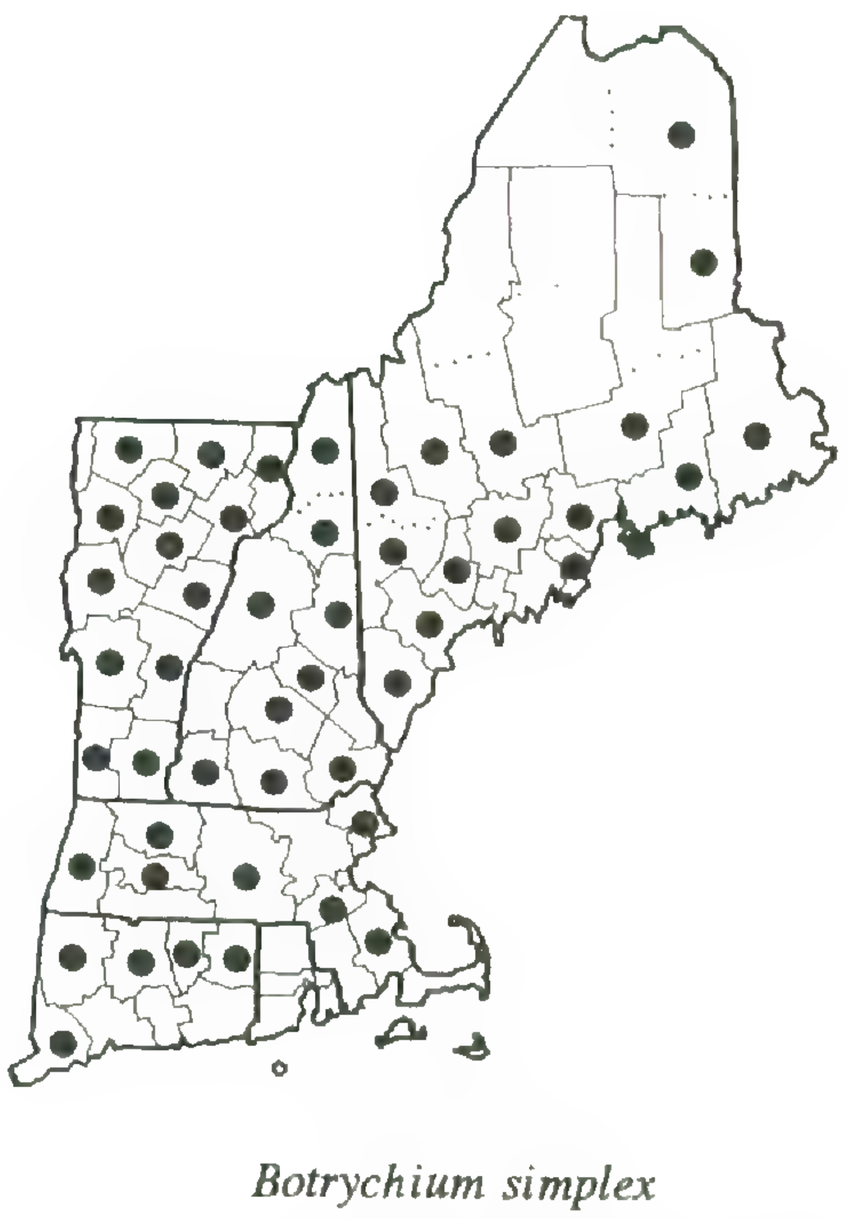
Botrychium minganense



Botrychium multifidum

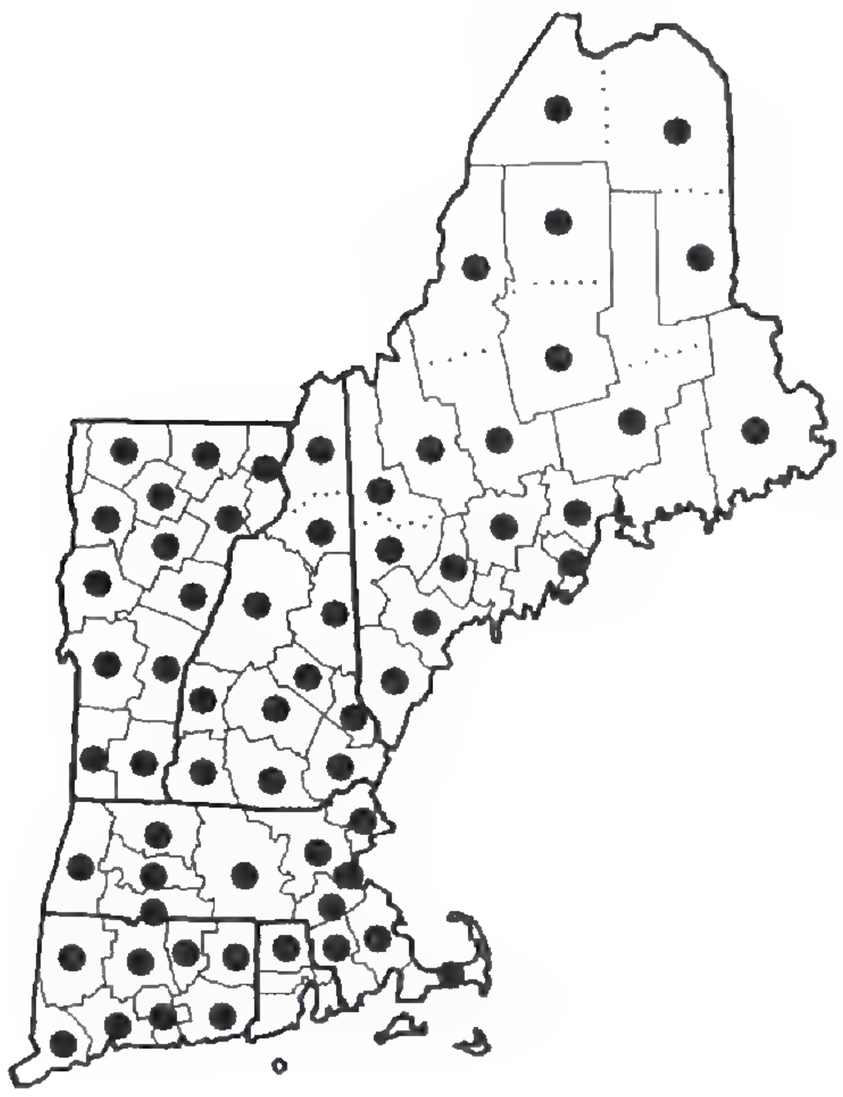


Botrychium rugulosum

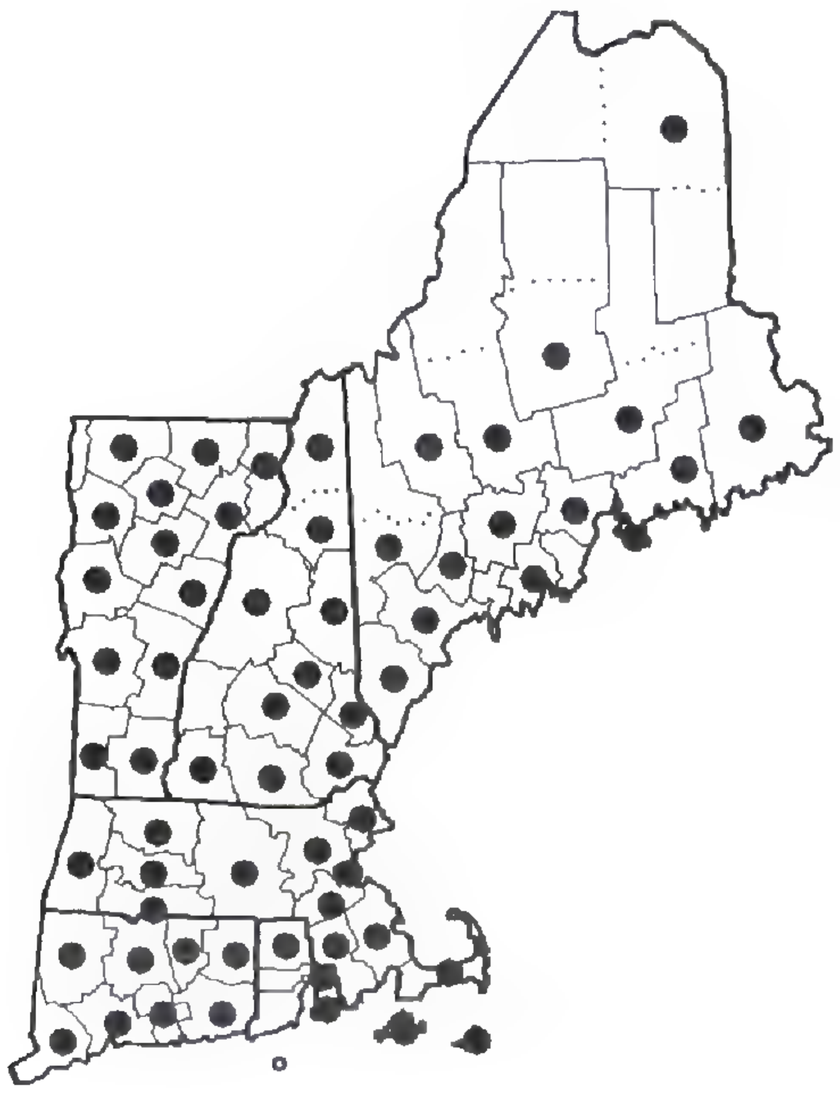


Botrychium simplex

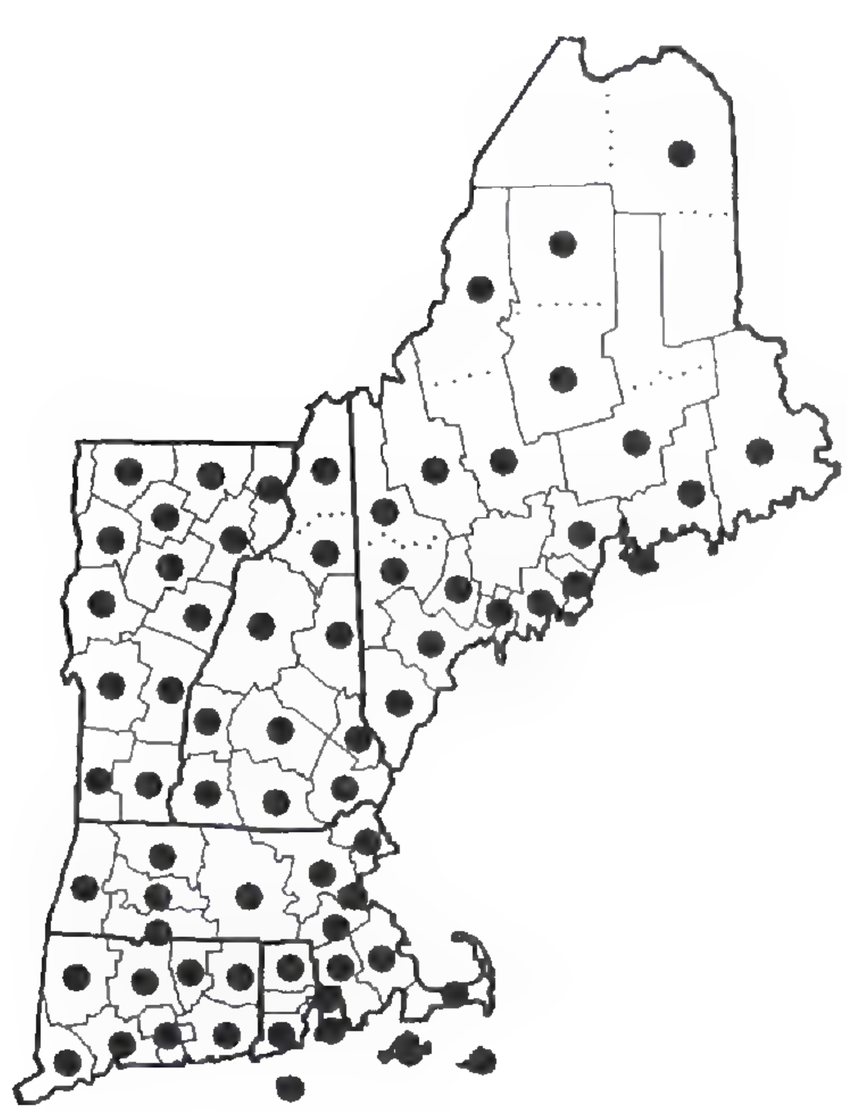
Figure 32. Distribution maps for *Botrychium minganense*, *B. multifidum*, *B. rugulosum*, and *B. simplex*.



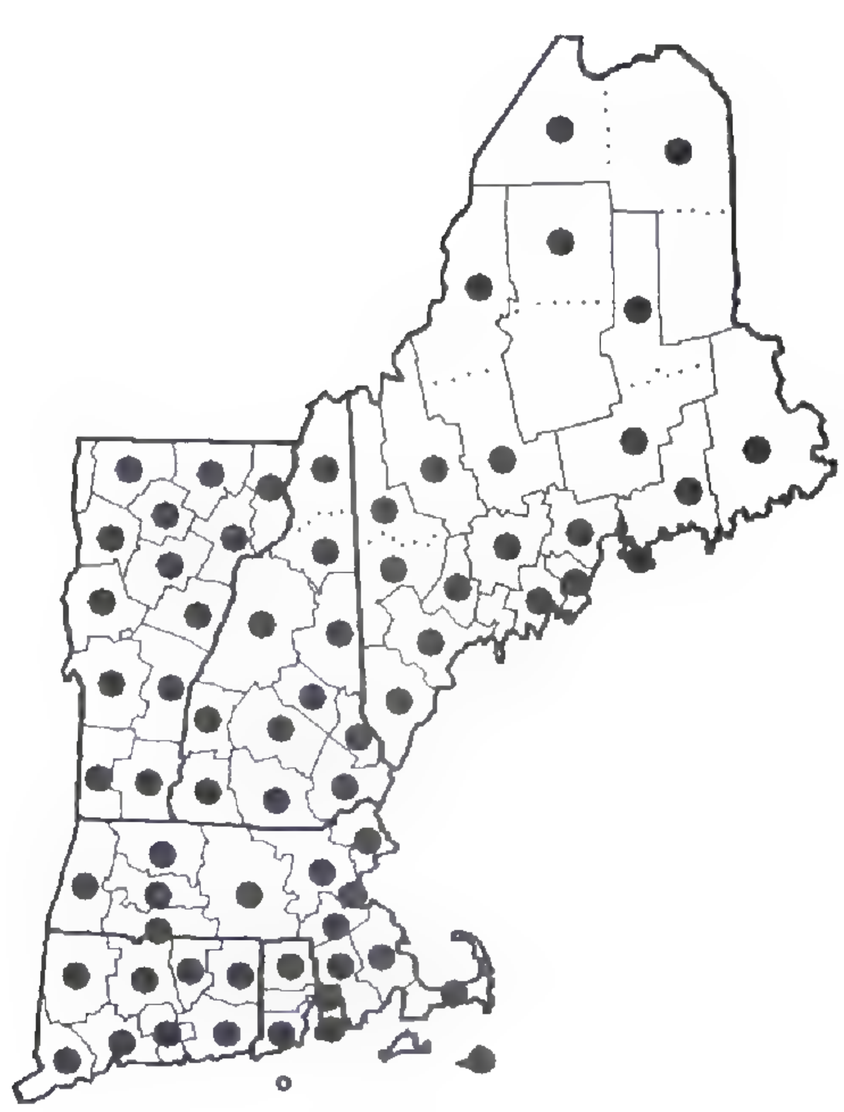
Botrychium virginianum



Ophioglossum pusillum

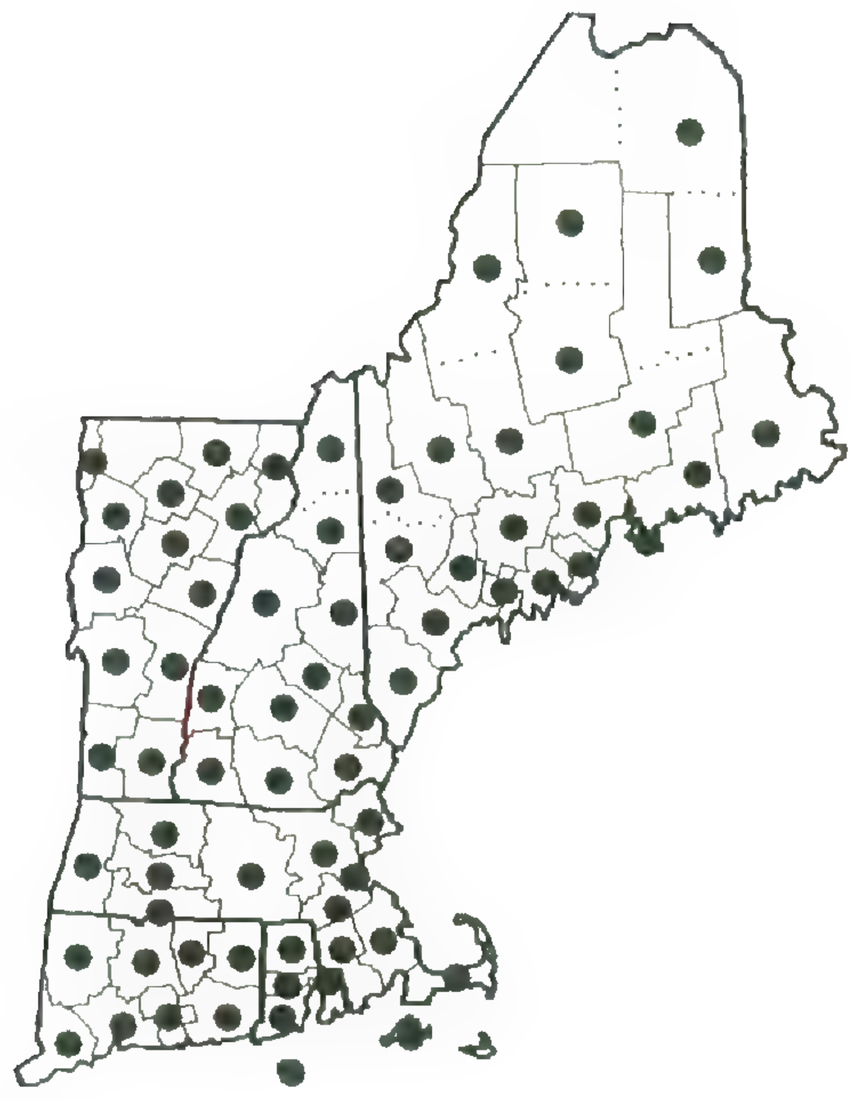


Osmunda cinnamomea

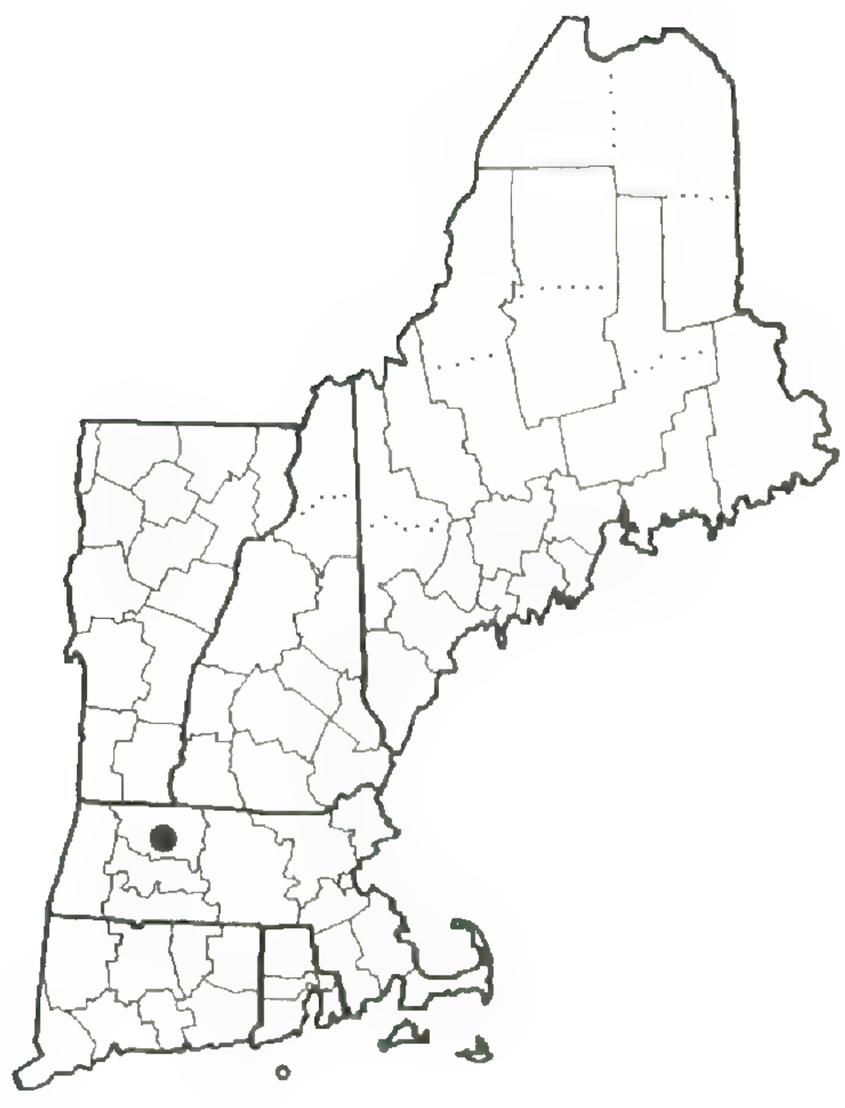


Osmunda claytoniana

Figure 33. Distribution maps for *Botrychium virginianum*, *Ophioglossum pusillum*, *Osmunda cinnamomea*, and *O. claytoniana*.

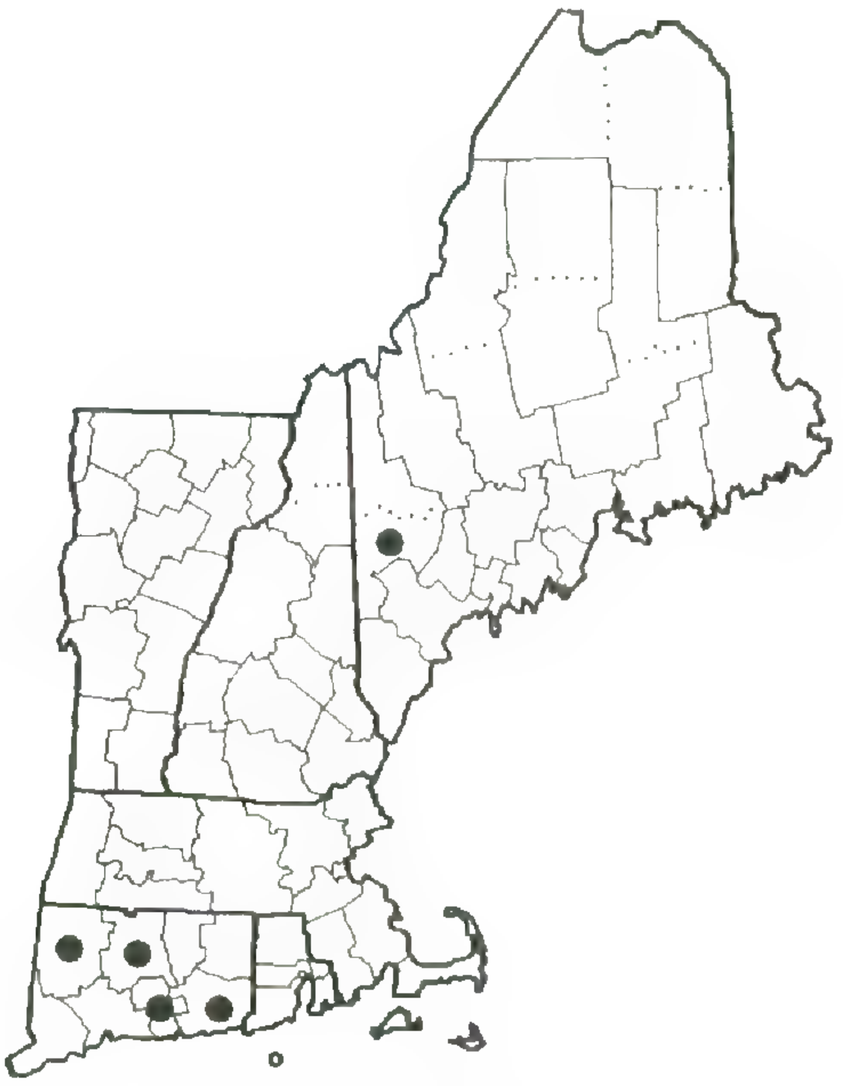


Osmunda regalis
var. *spectabilis*



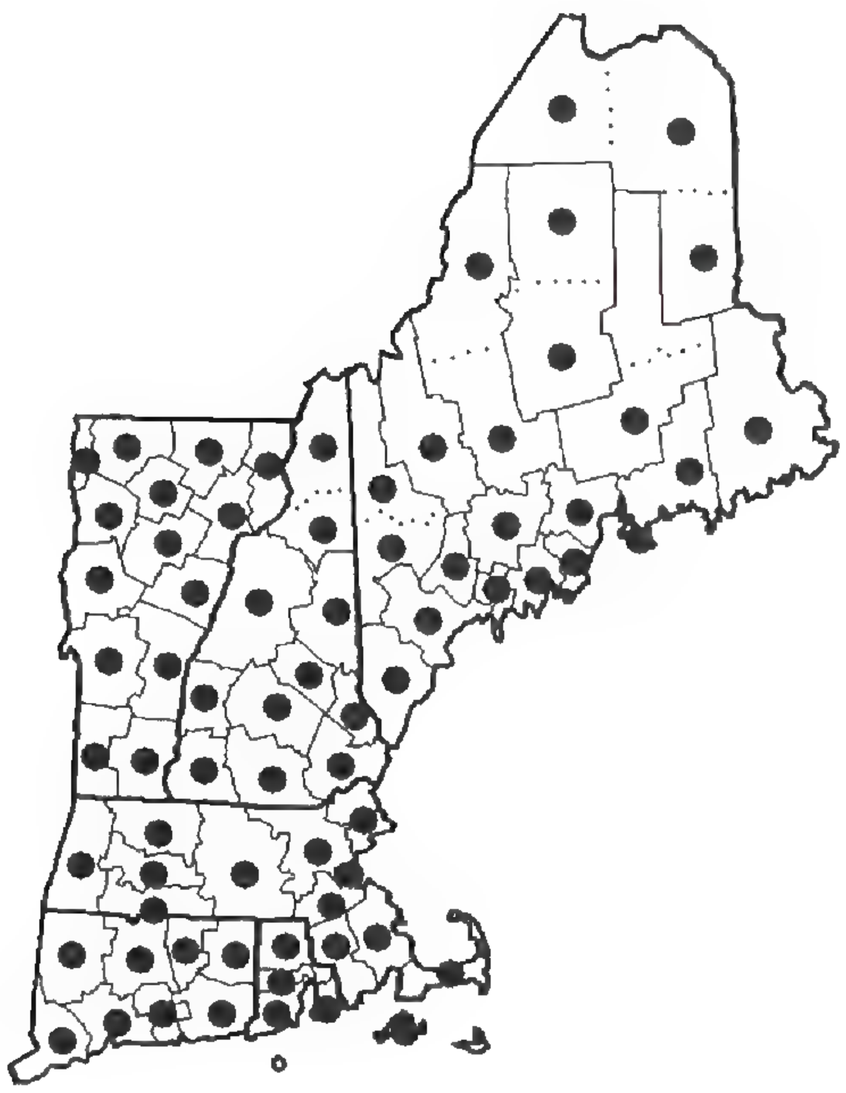
Osmunda cinnamomea x
O. claytoniana

Osmunda x *ruggii*

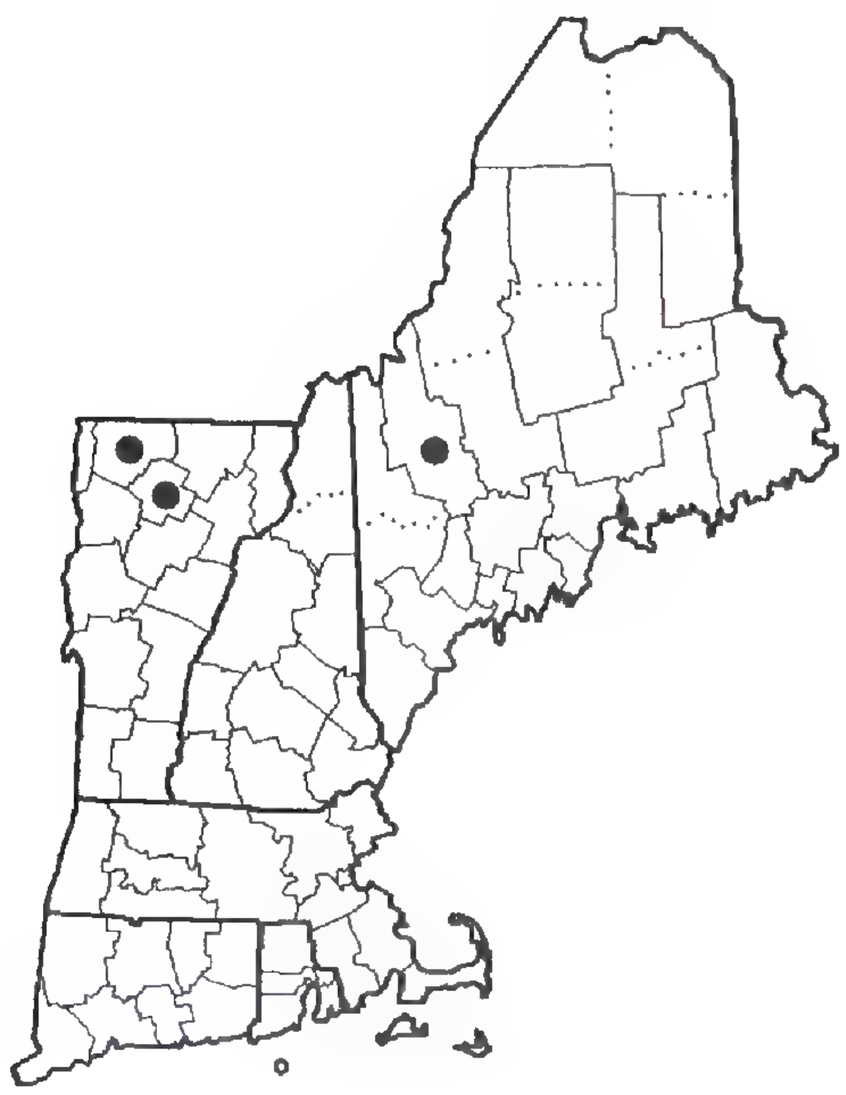


Polypodium appalachianum

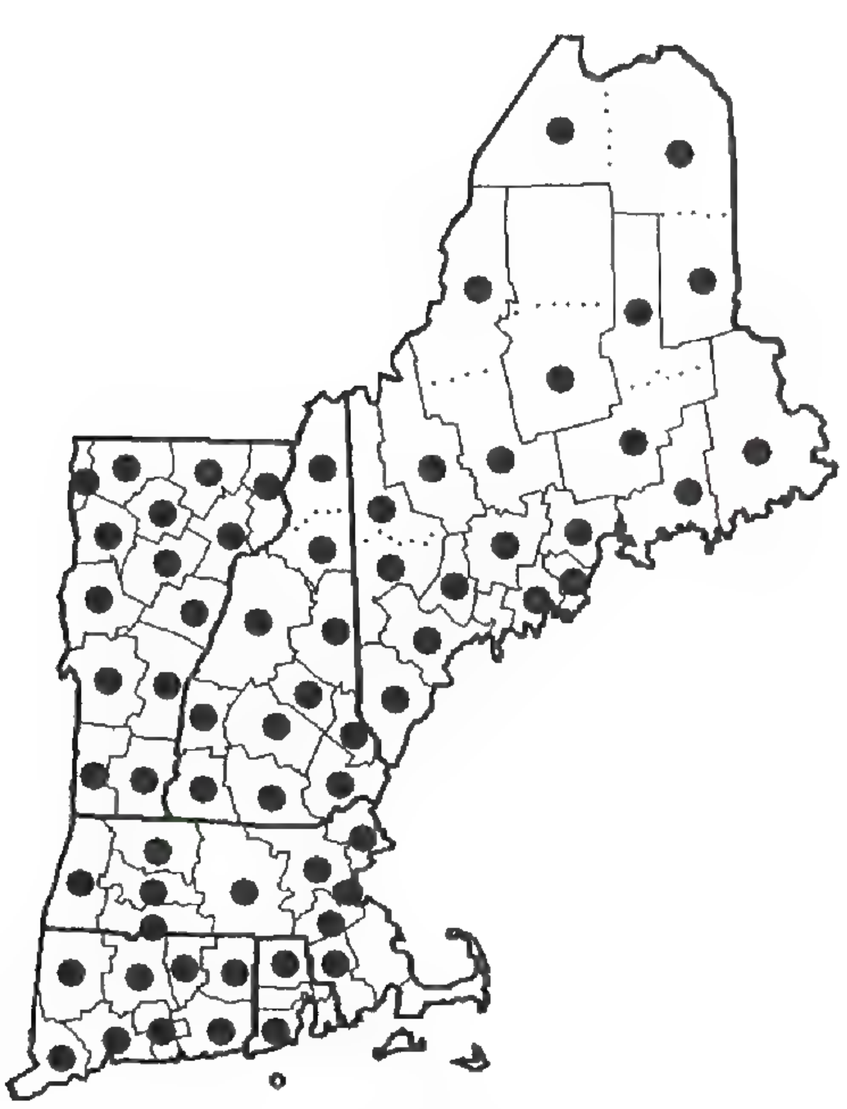
Figure 34. Distribution maps for *Osmunda regalis* var. *spectabilis*, *O. cinnamomea* × *O. claytoniana*, *O.* × *ruggii*, and *Polypodium appalachianum*.



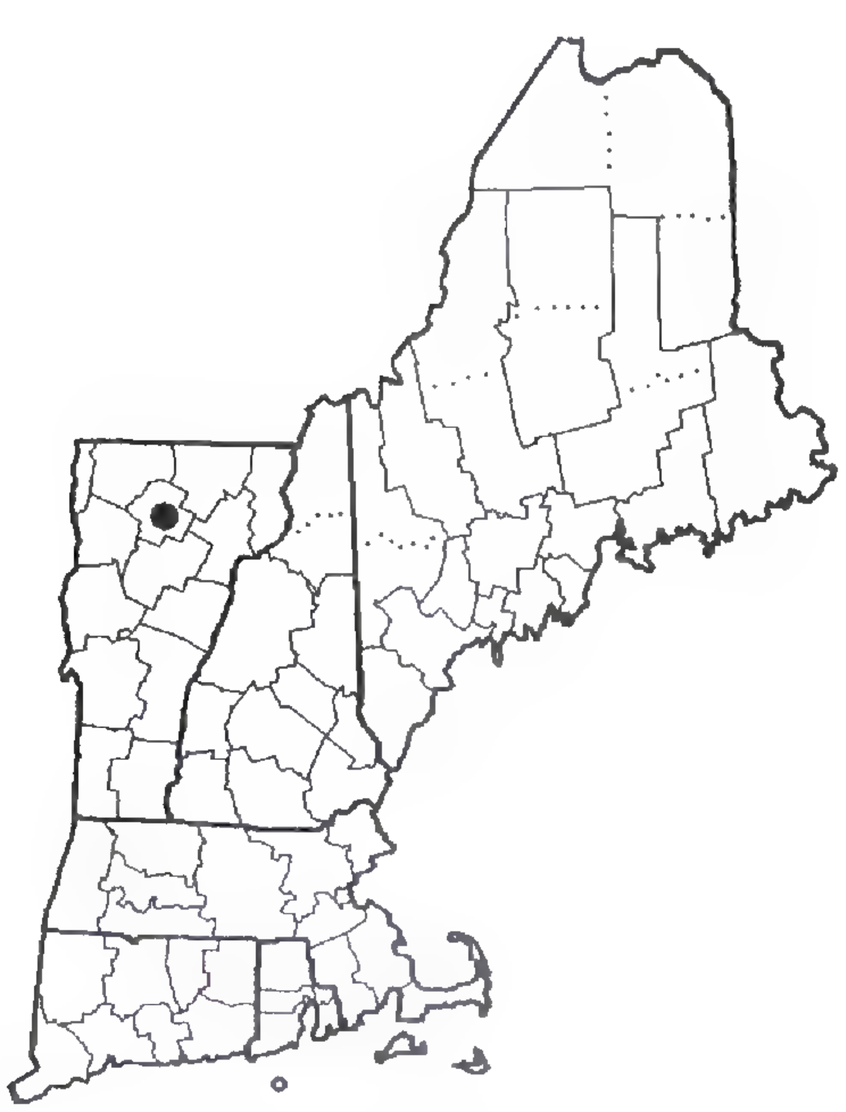
Polypodium virginianum



Adiantum aleuticum

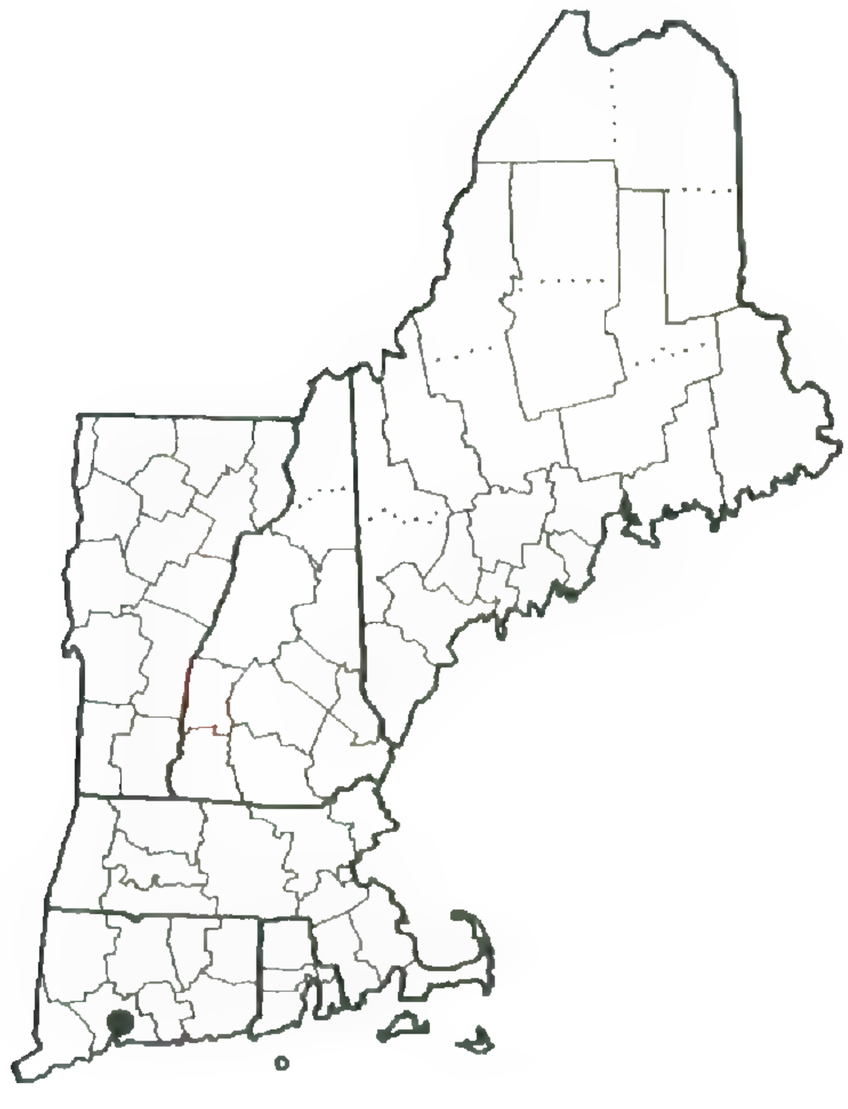


Adiantum pedatum

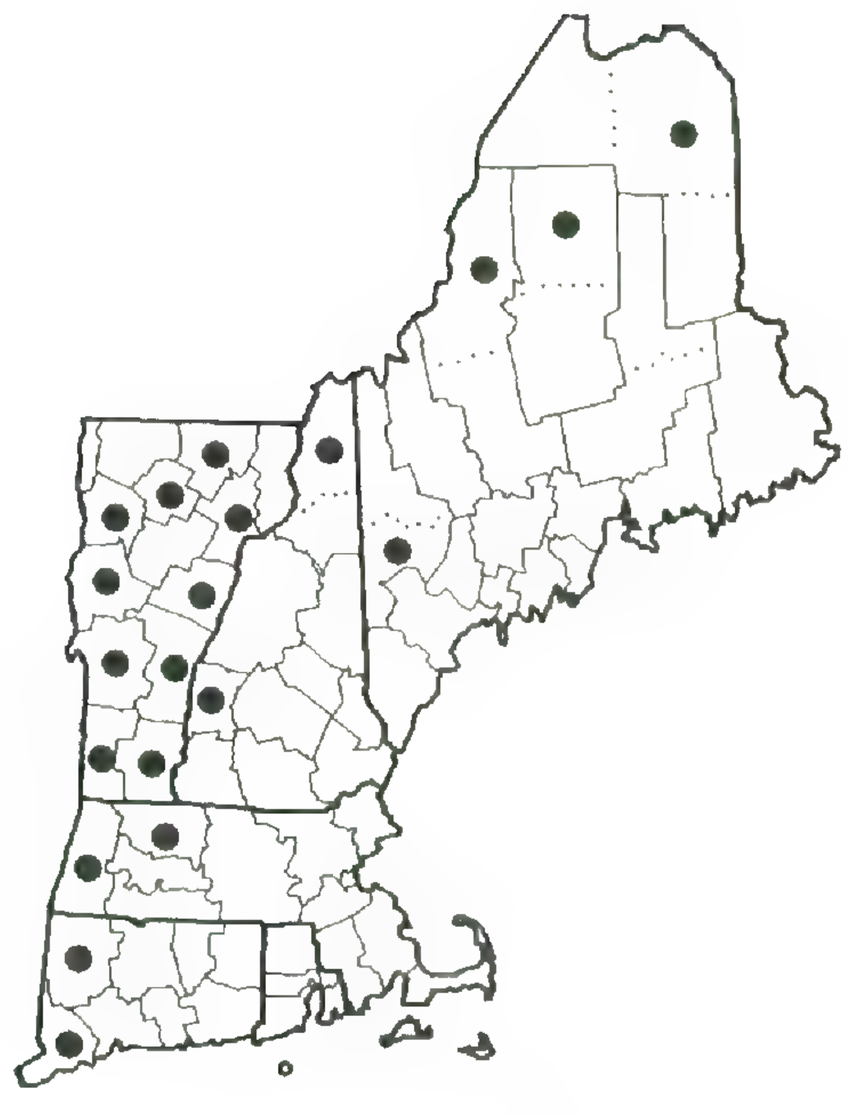


Adiantum x *viridimontanum*

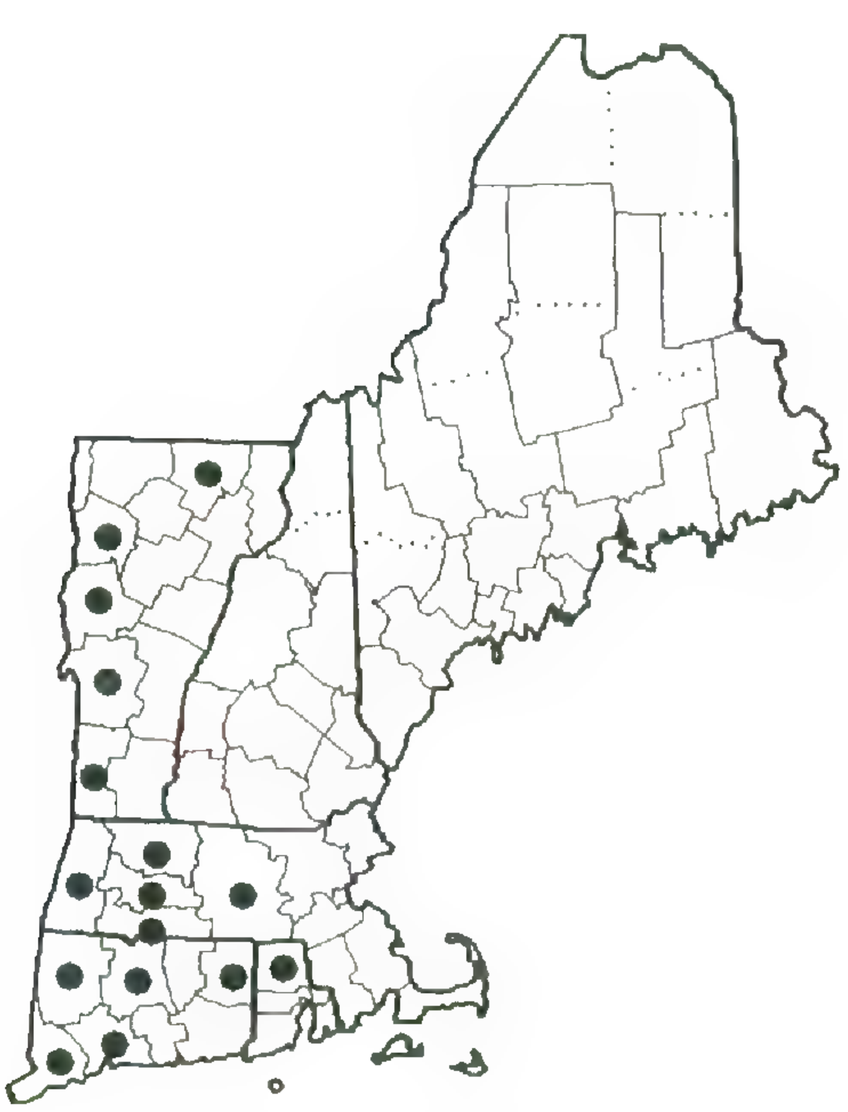
Figure 35. Distribution maps for *Polypodium virginianum, Adiantum aleuticum, A. pedatum,* and *A.* × *viridimontanum.*



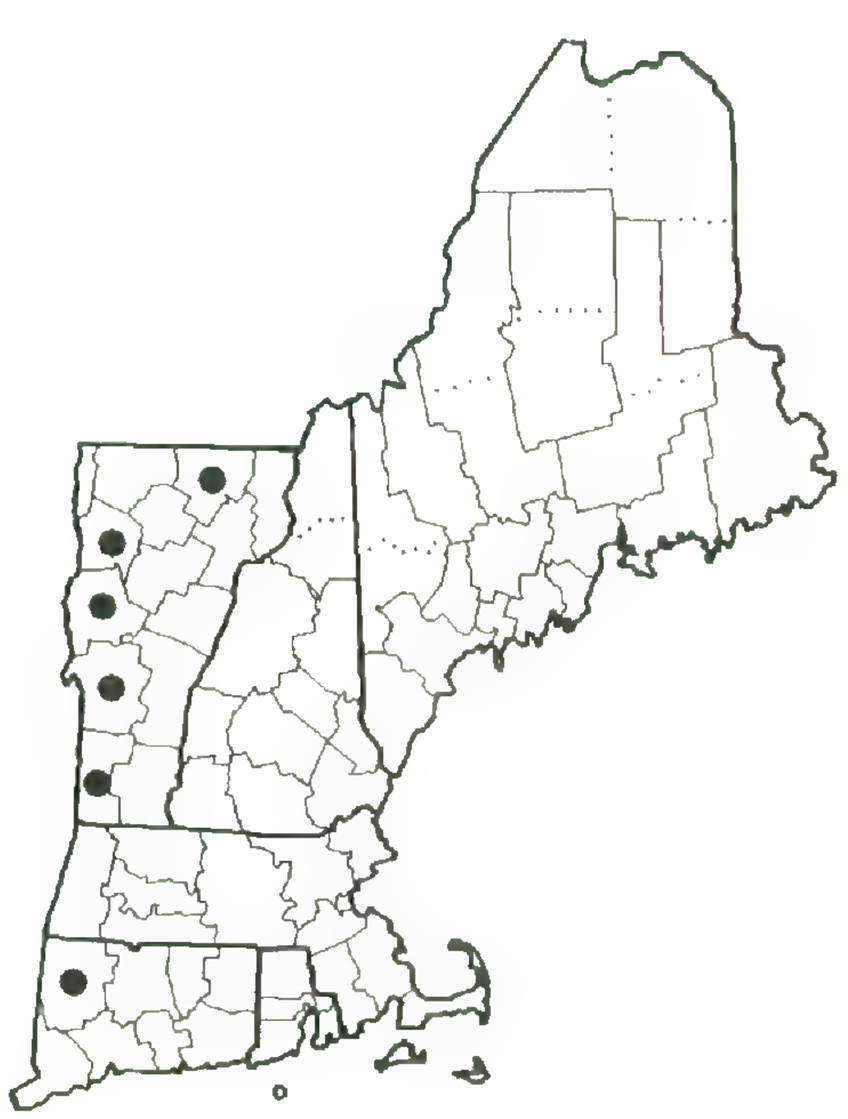
Cheilanthes lanosa



Cryptogramma stelleri

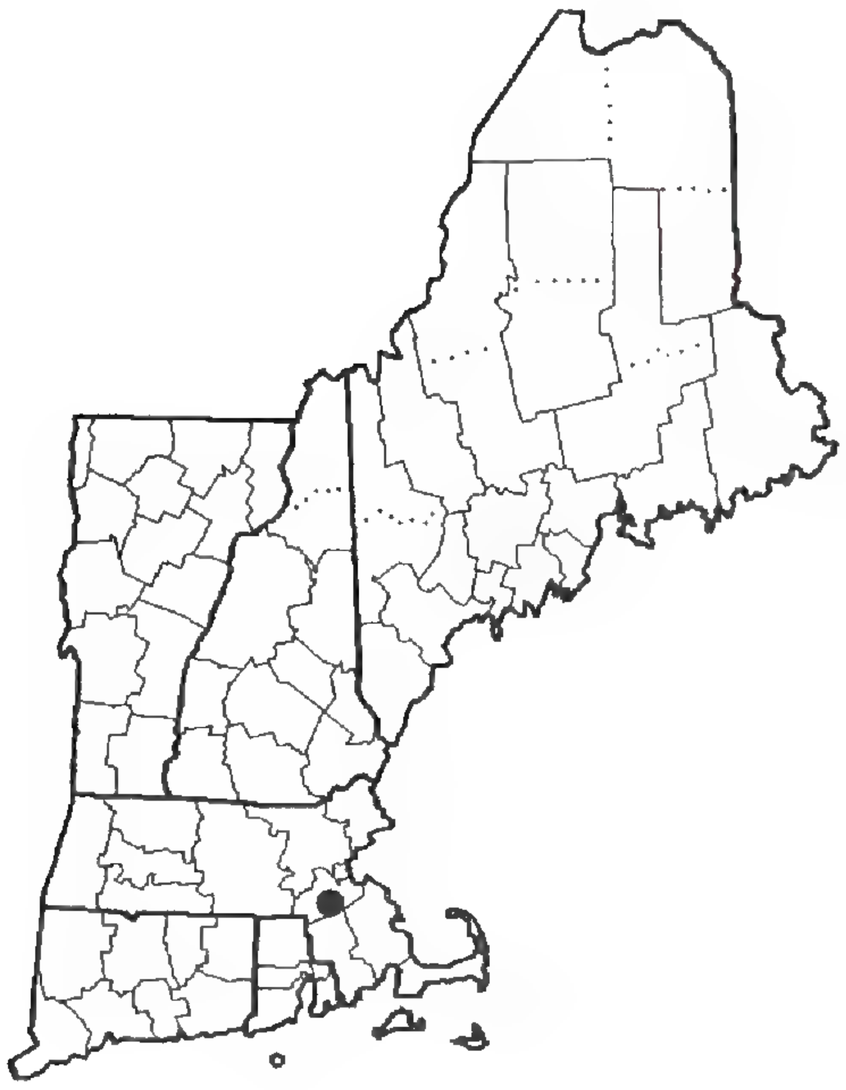


Pellaea atropurpurea

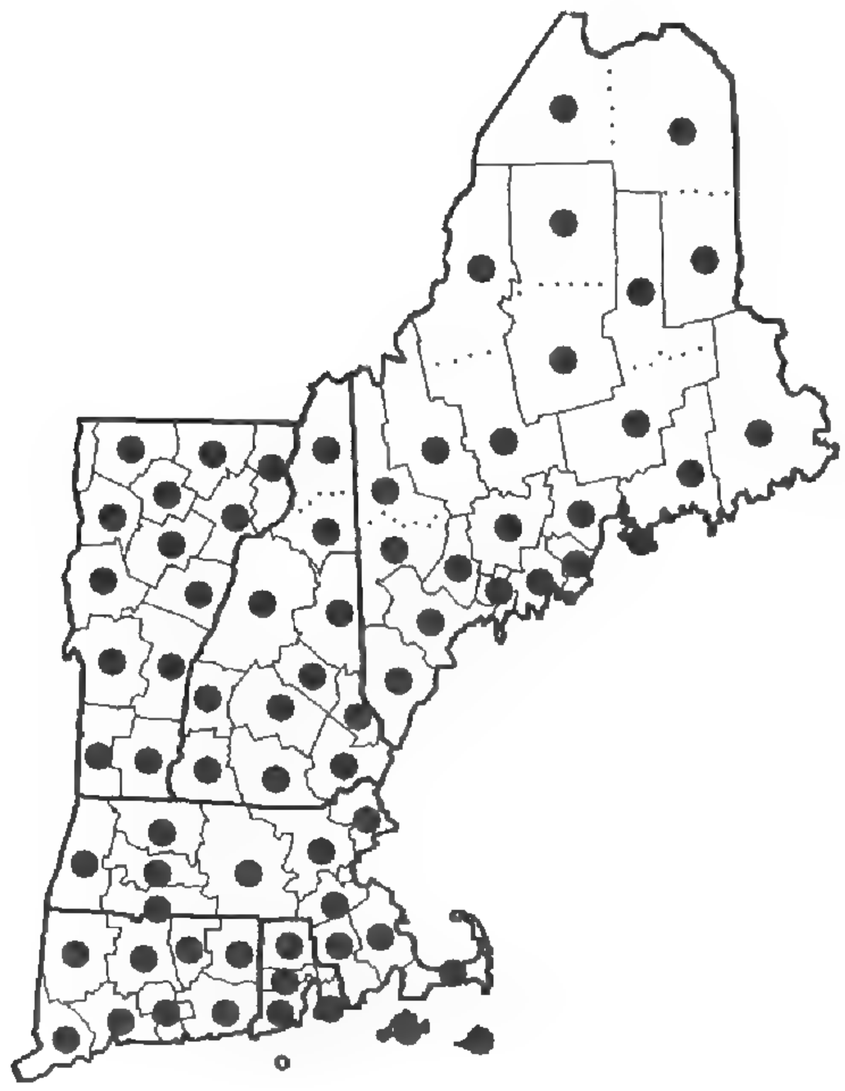


Pellaea glabella

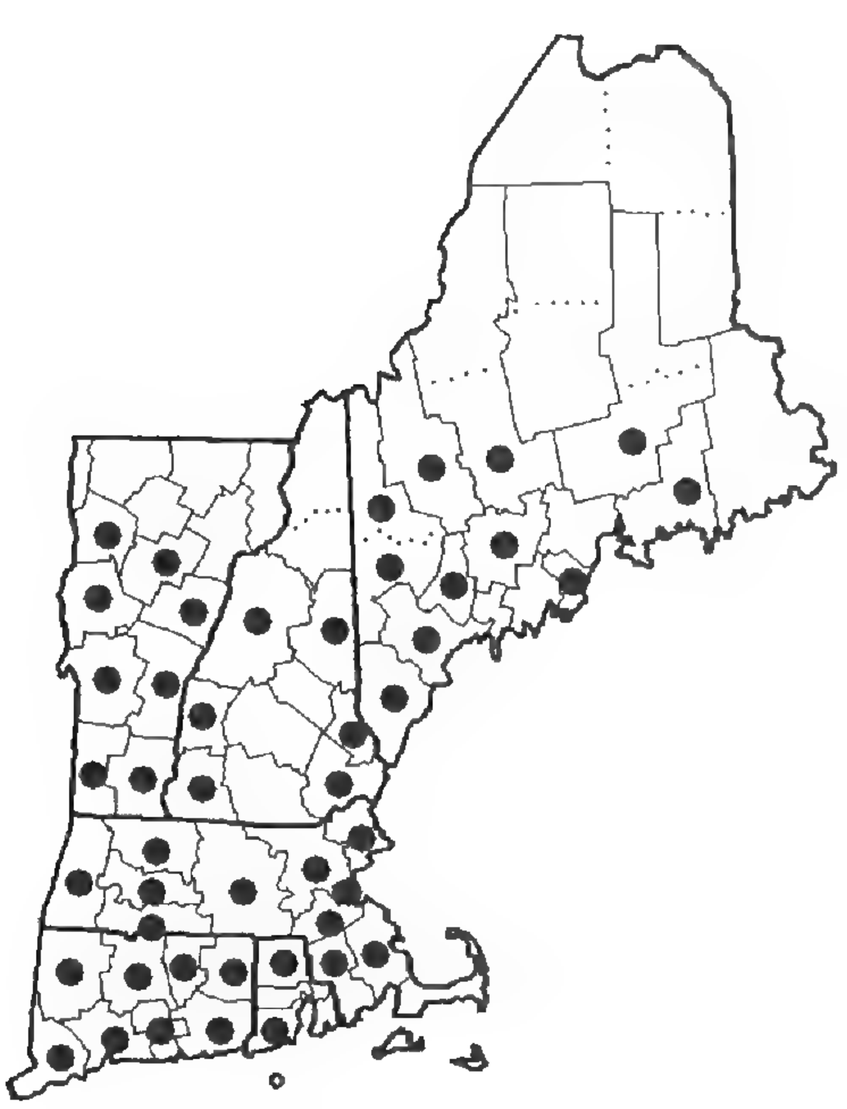
Figure 36. Distribution maps for *Cheilanthes lanosa*, *Cryptogramma stelleri*, *Pellaea atropurpurea*, and *P. glabella*.



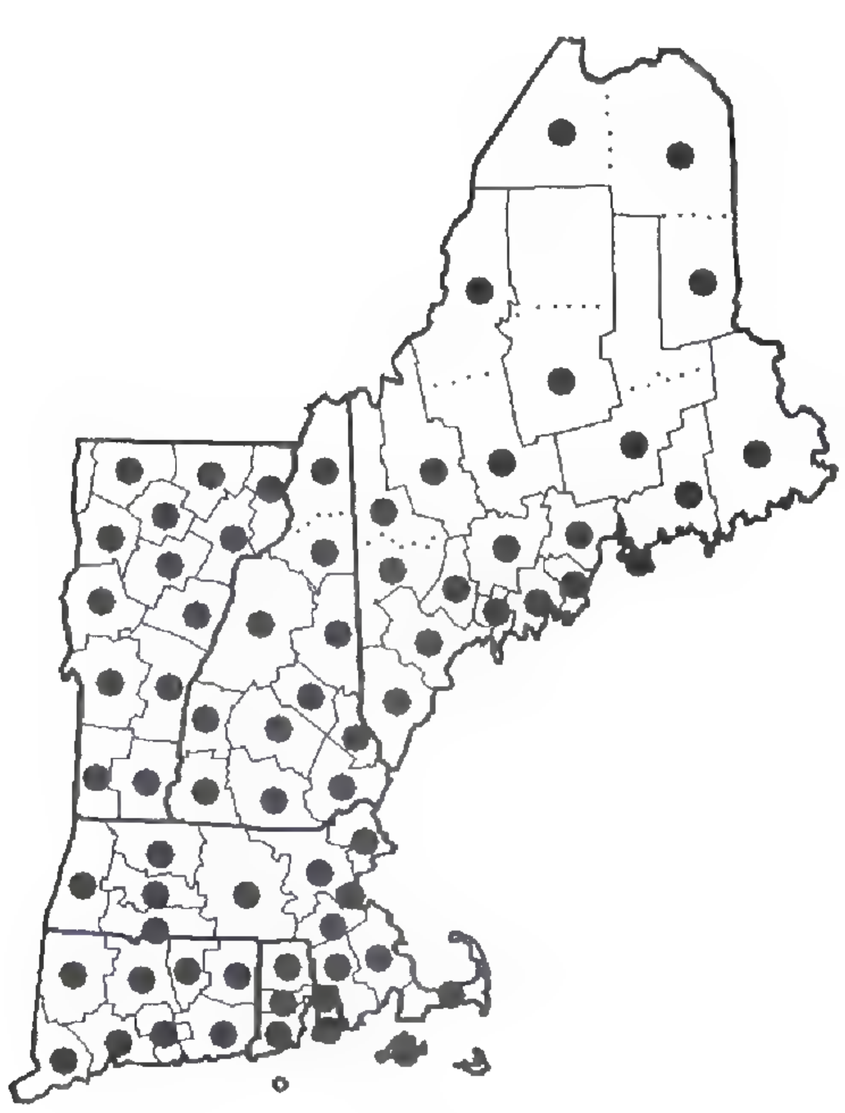
SALVINIA NATANS



Phegopteris connectilis

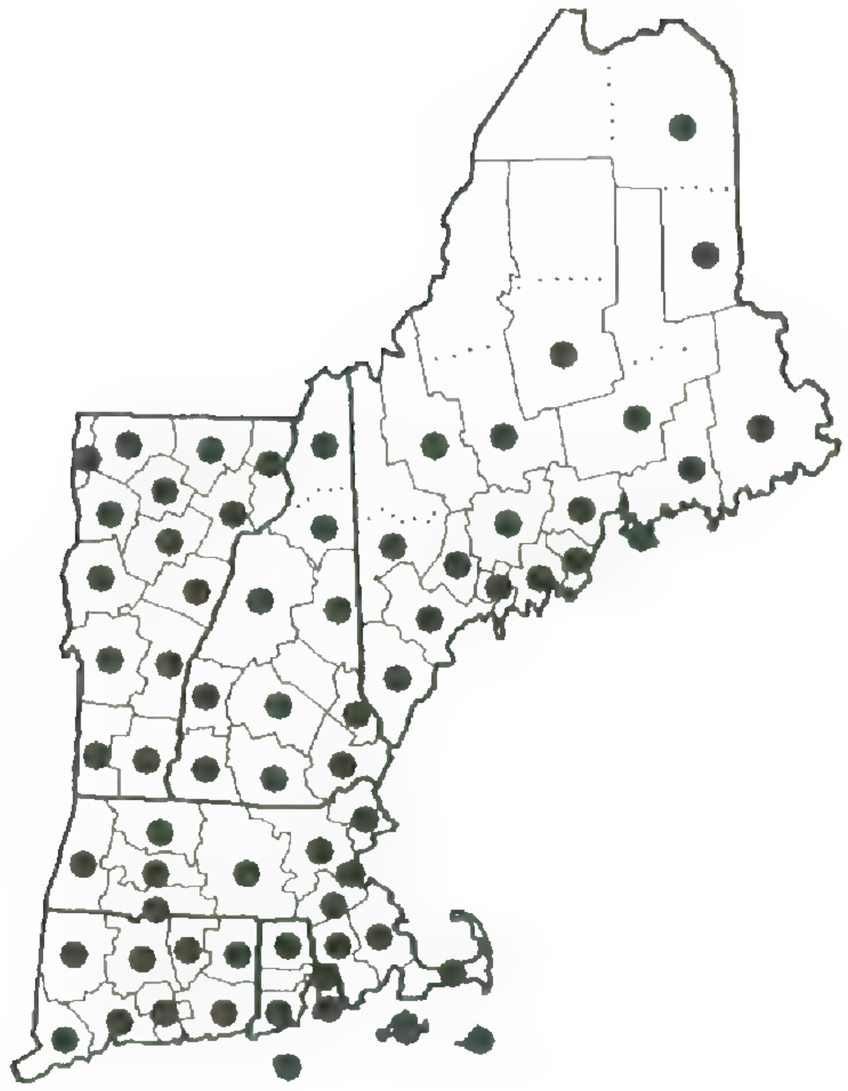


Phegopteris hexagonoptera

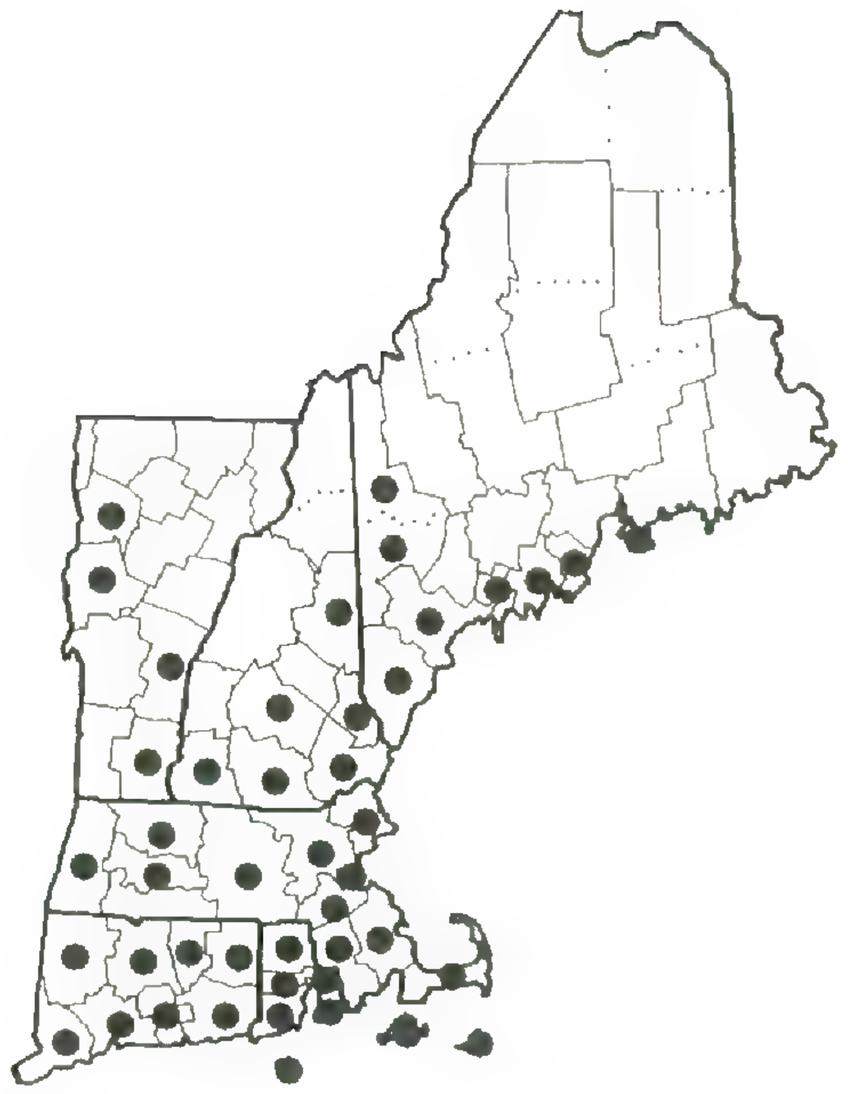


Thelypteris noveboracensis

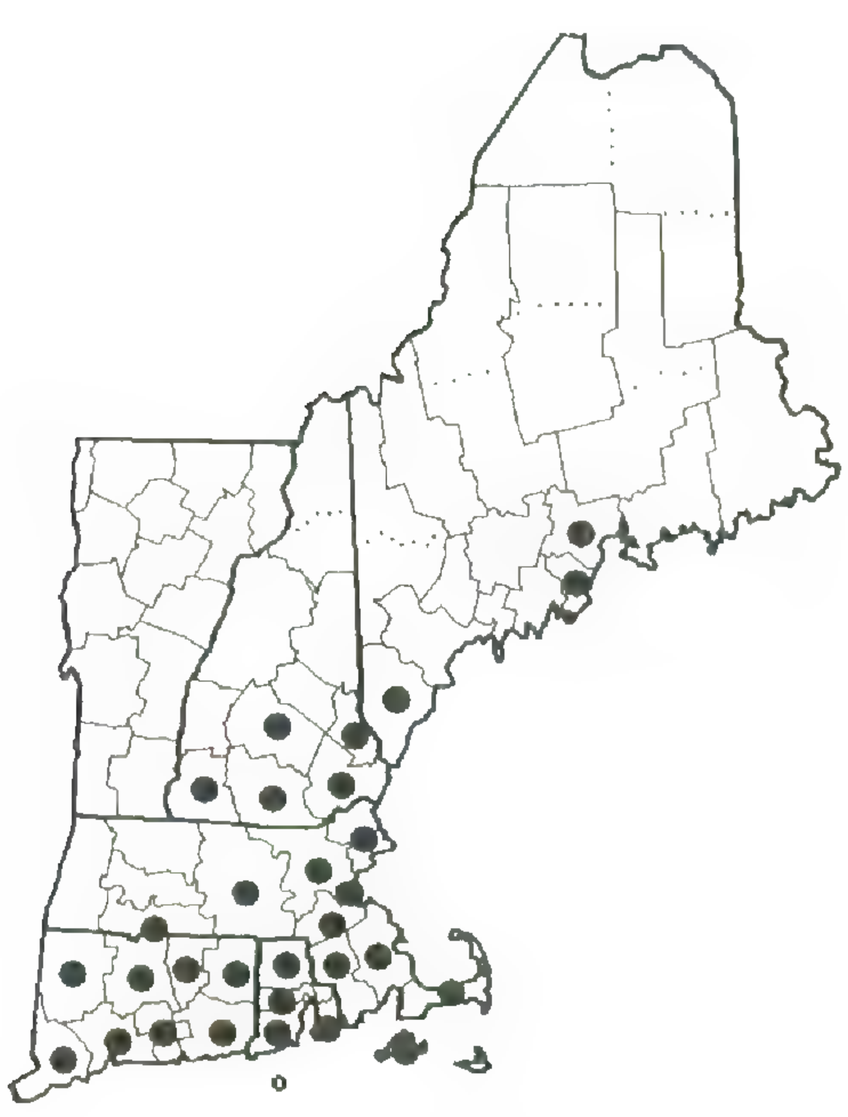
Figure 37. Distribution maps for *SALVINIA NATANS*, *Phegopteris connectilis*, *P. hexagonoptera*, and *Thelypteris noveboracensis*.



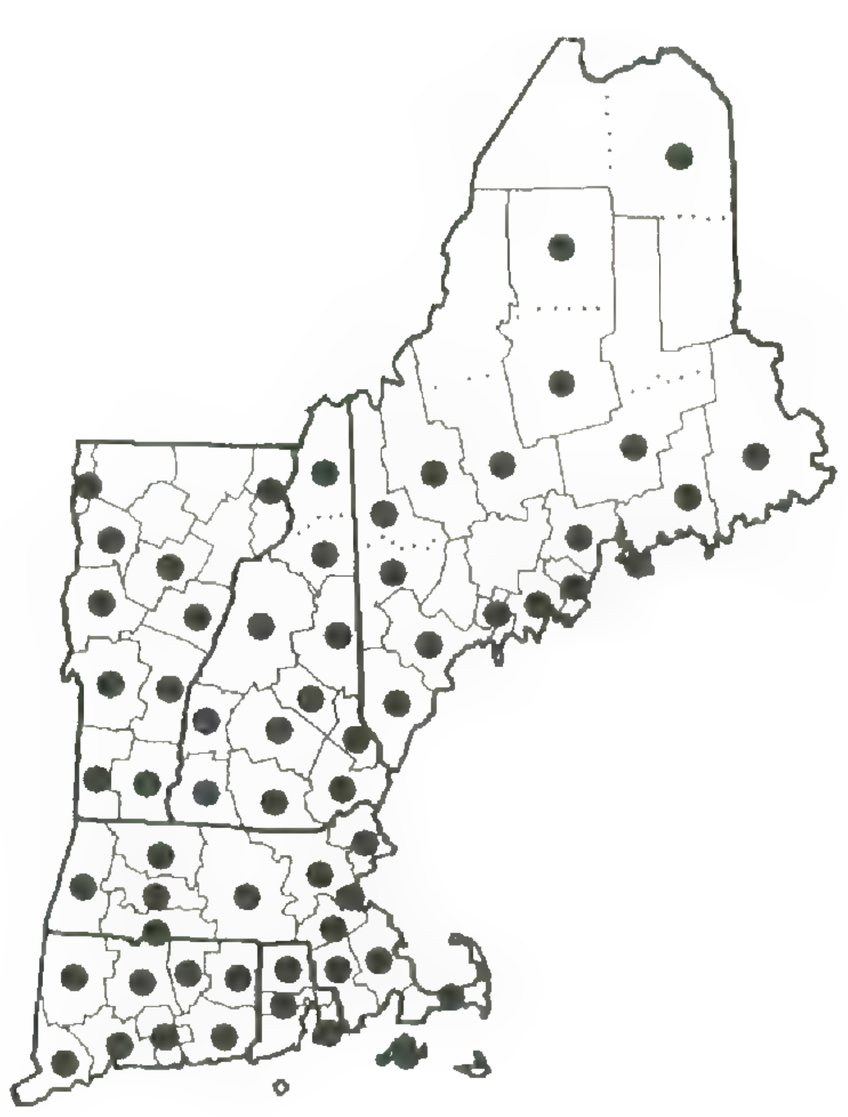
Thelypteris palustris var. *pubescens*



Thelypteris simulata

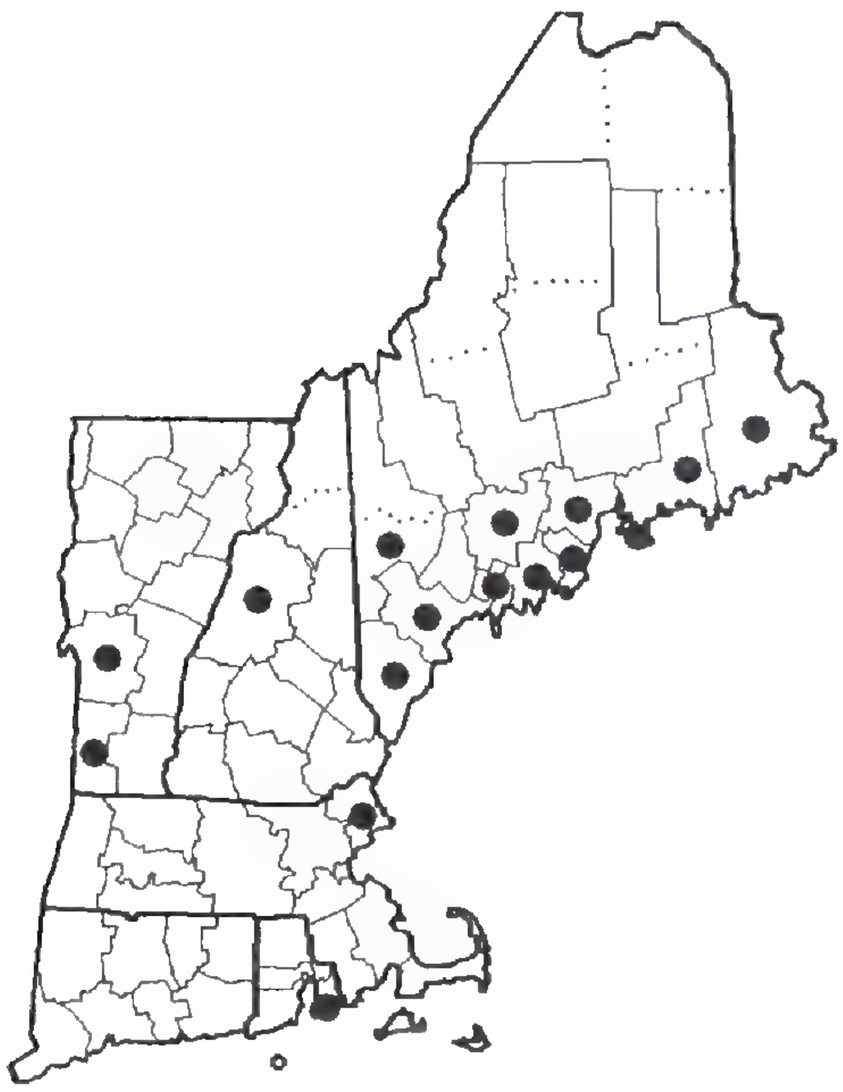


Chamaecyparis thyoides

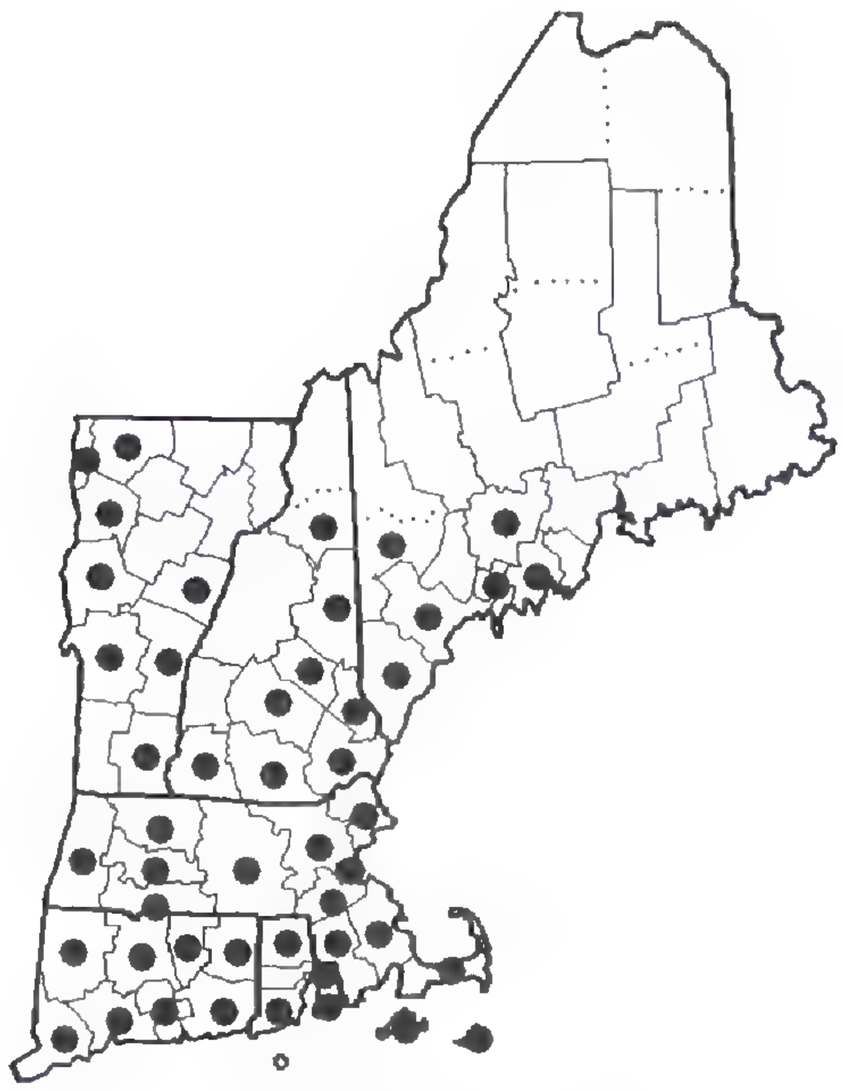


Juniperus communis var. *depressa*

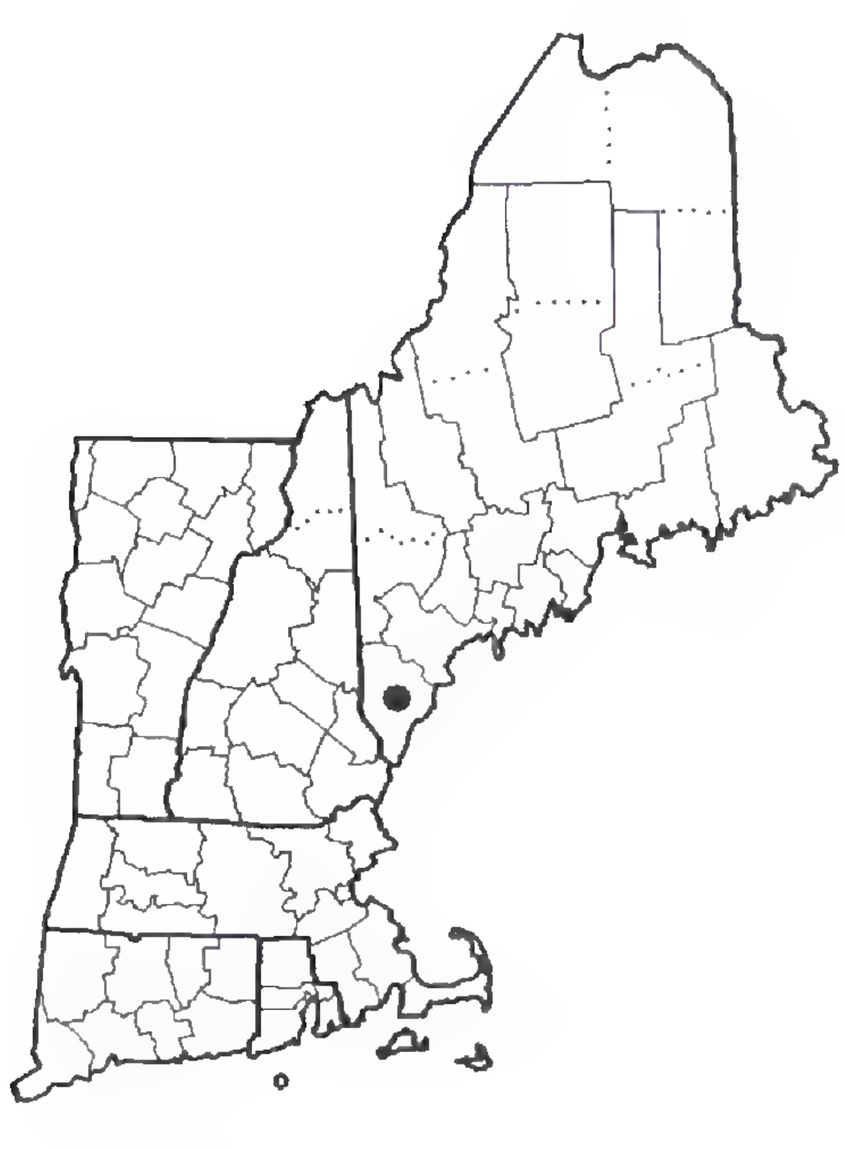
Figure 38. Distribution maps for *Thelypteris palustris* var. *pubescens*, *T. simulata*, *Chamaecyparis thyoides*, and *Juniperus communis* var. *depressa*.



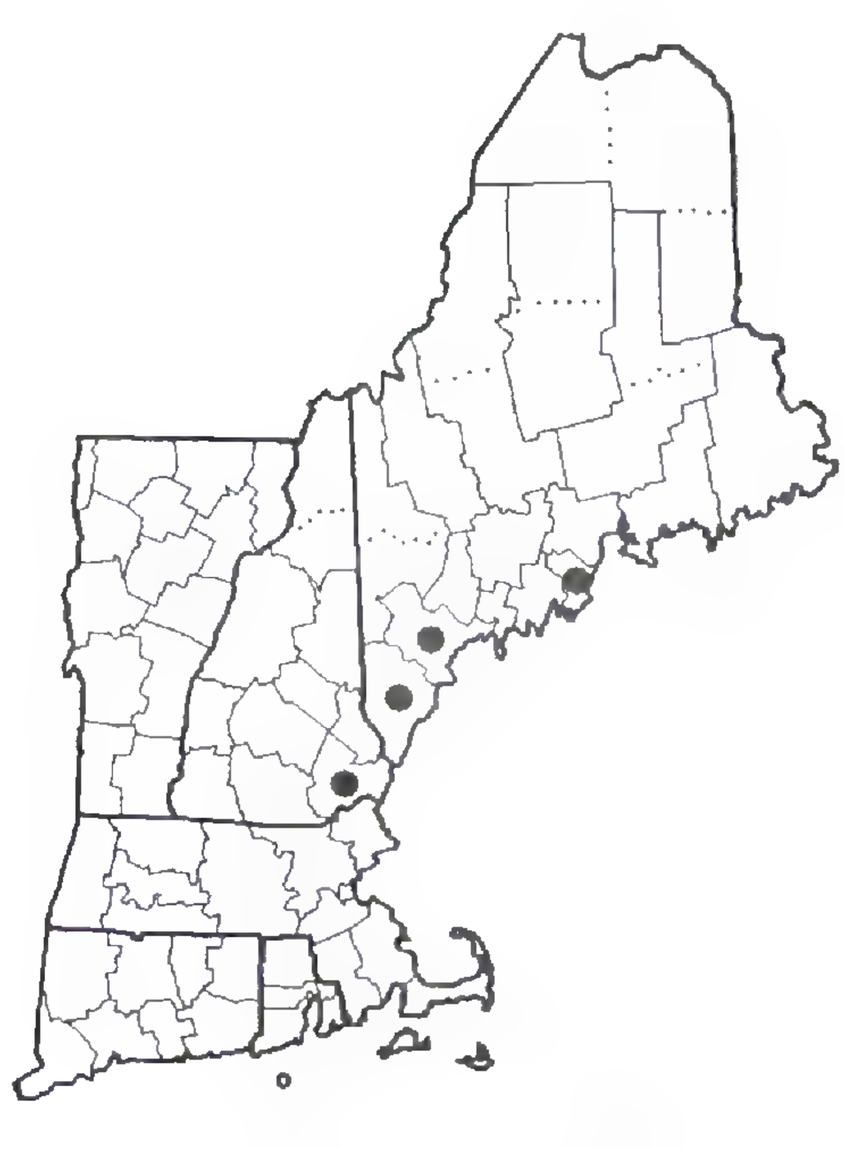
Juniperus horizontalis



Juniperus virginiana

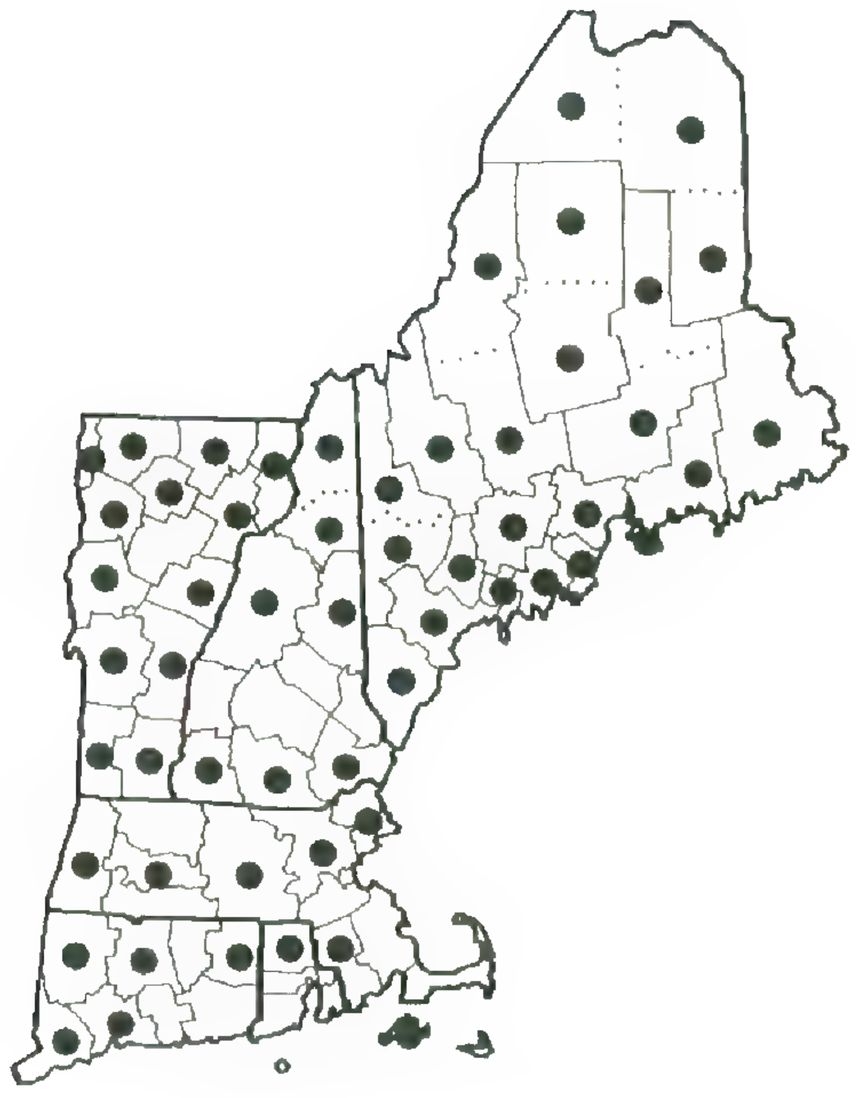


Juniperus communis var. *depressa* x *J. virginiana*

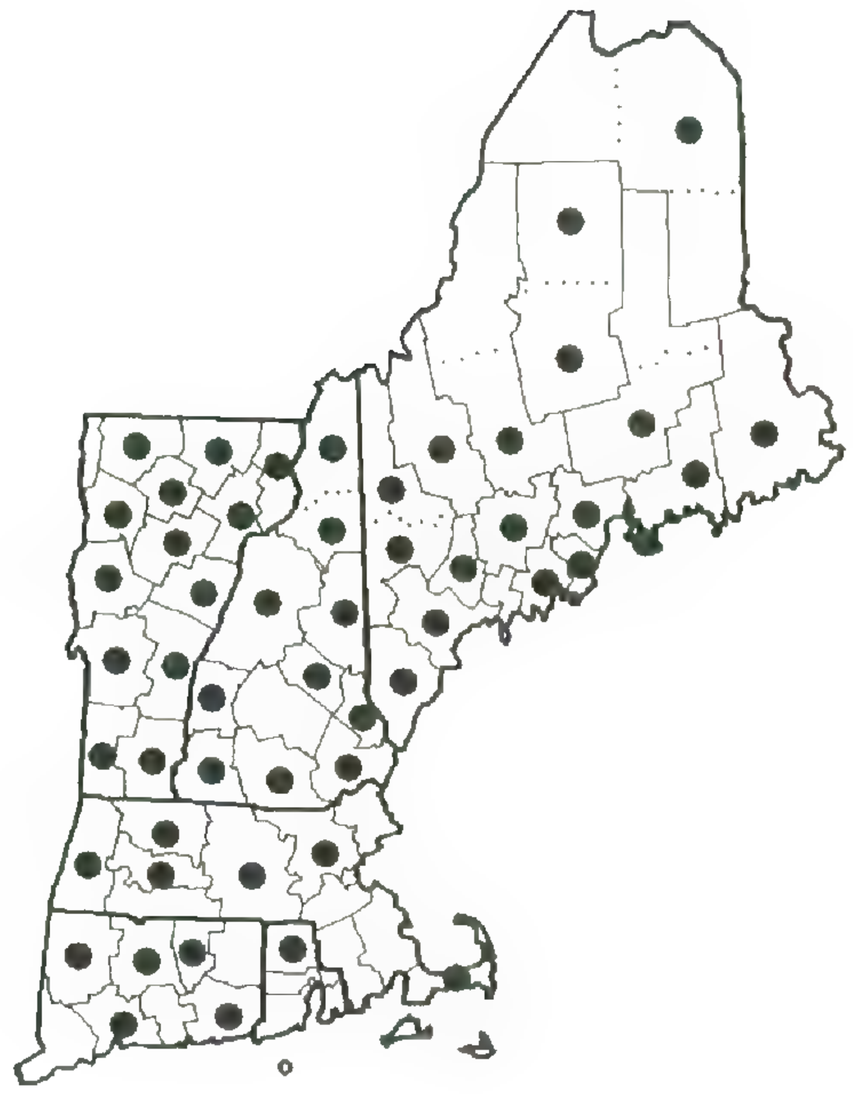


Juniperus horizontalis x *J. virginiana*

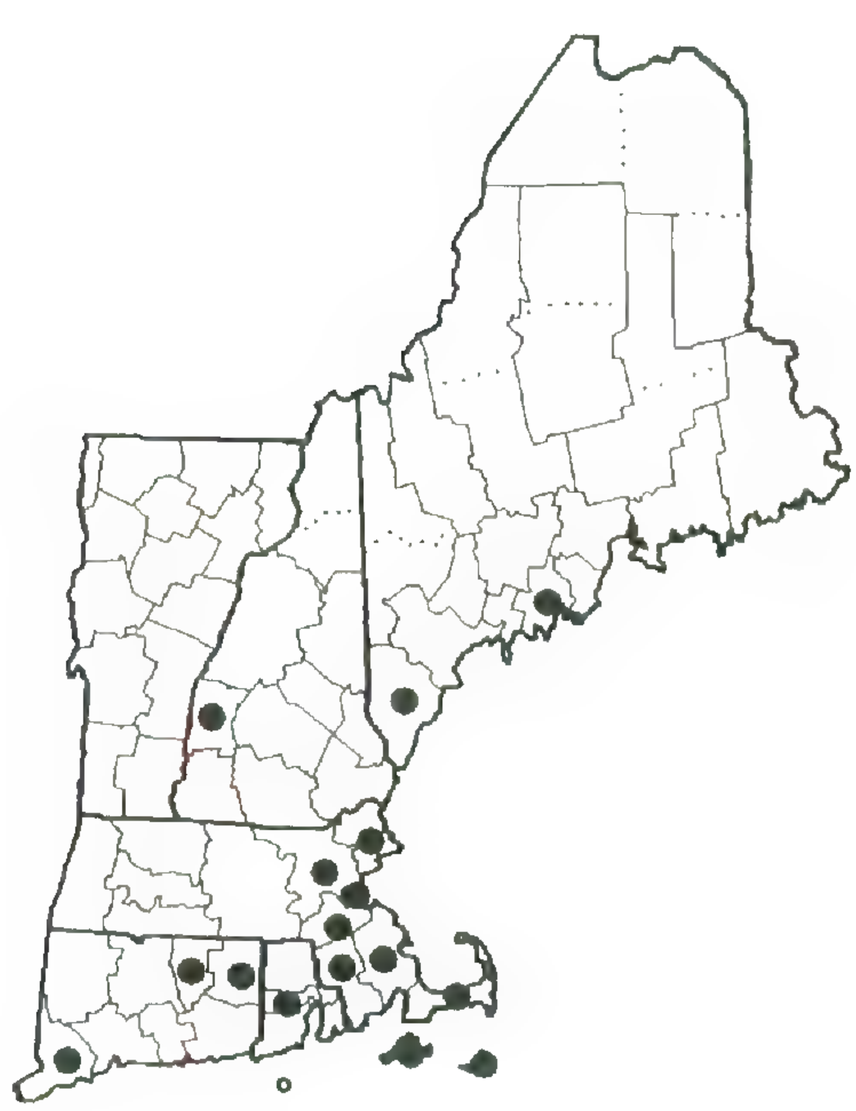
Figure 39. Distribution maps for *Juniperus horizontalis*, *J. virginiana*, *J. communis* var. *depressa* × *J. virginiana*, and *J. horizontalis* × *J. virginiana*.



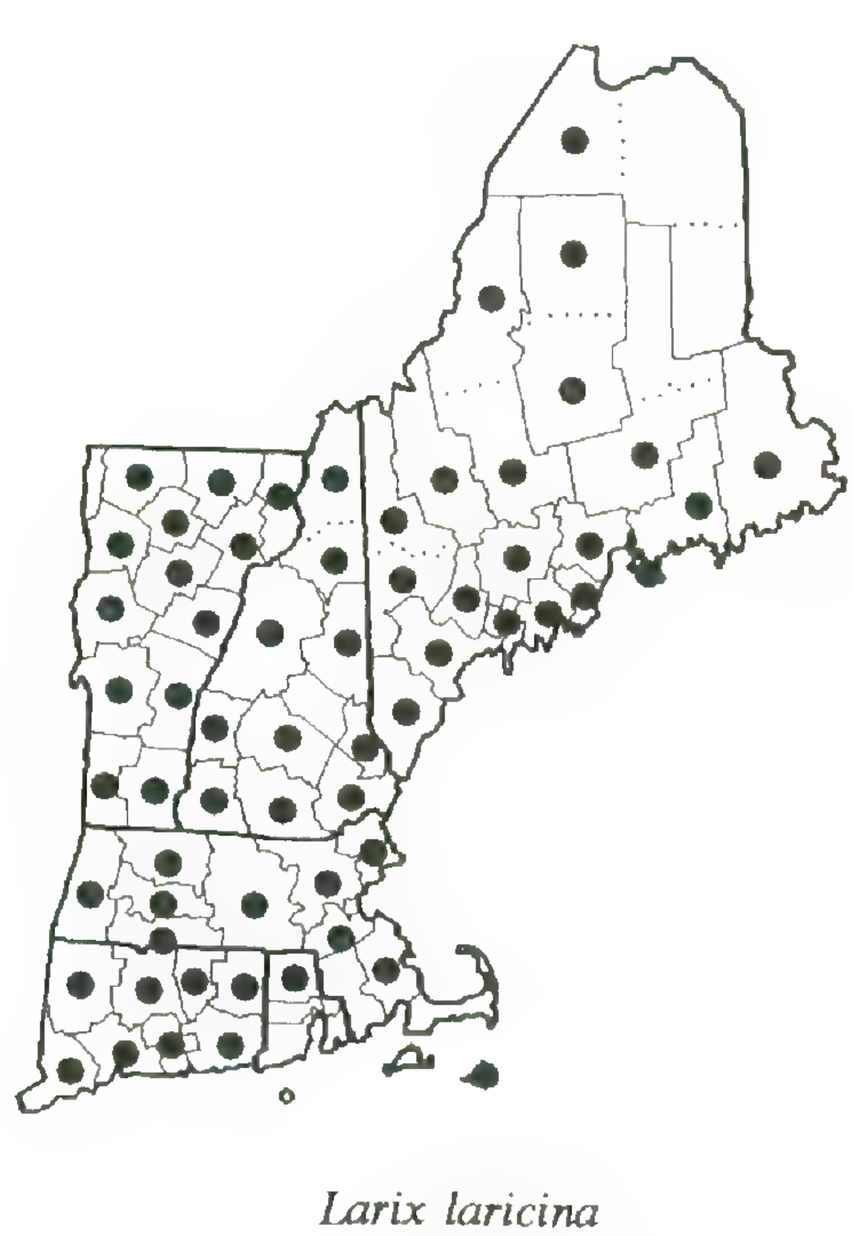
Thuja occidentalis



Abies balsamea

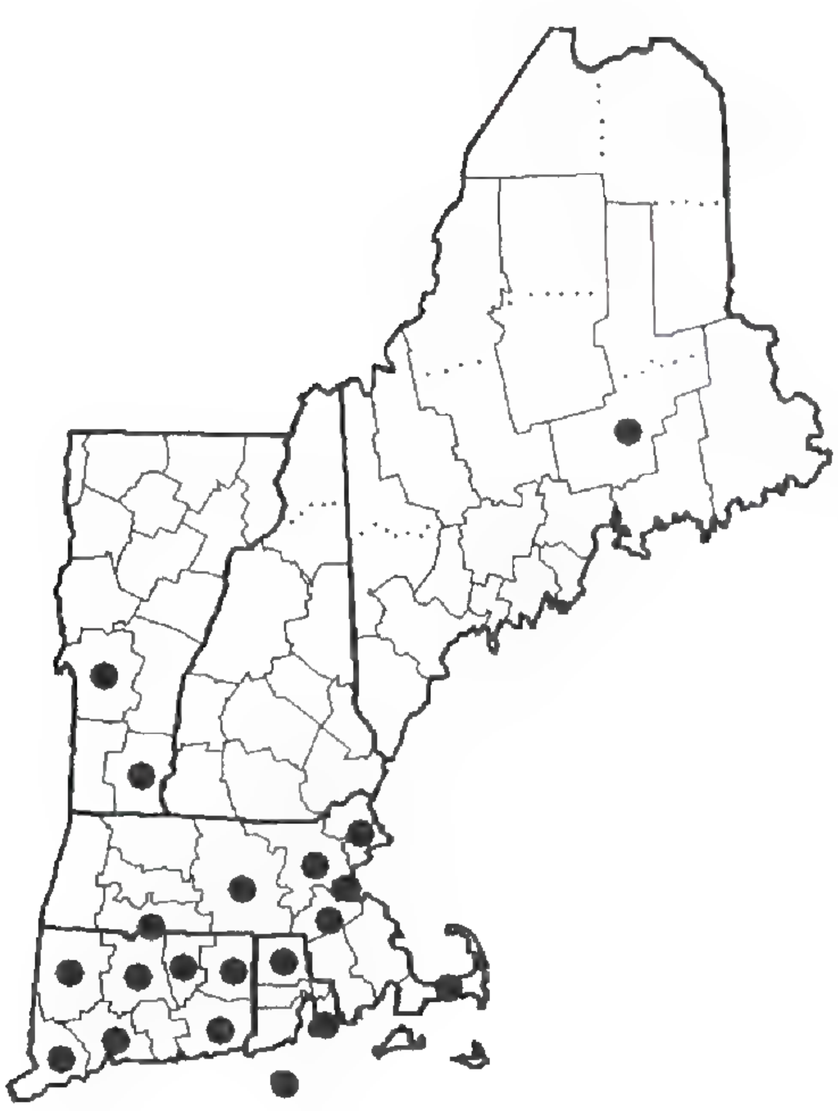


LARIX DECIDUA

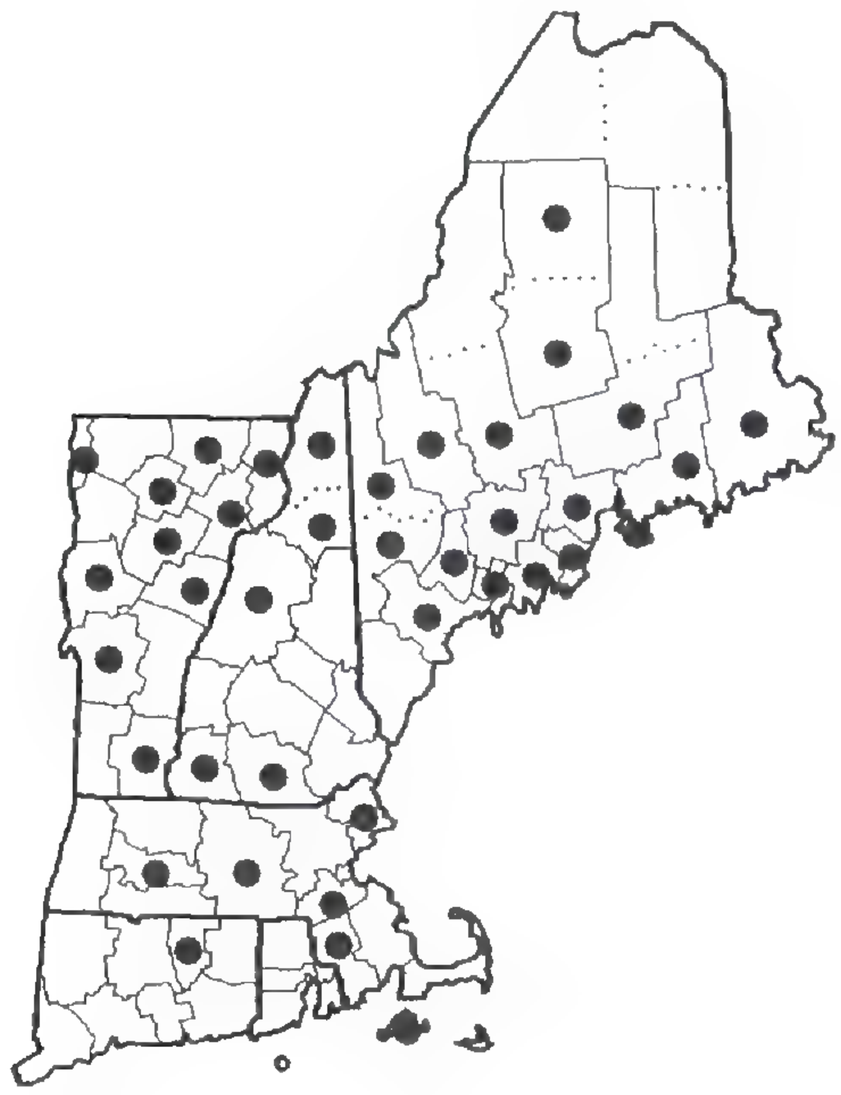


Larix laricina

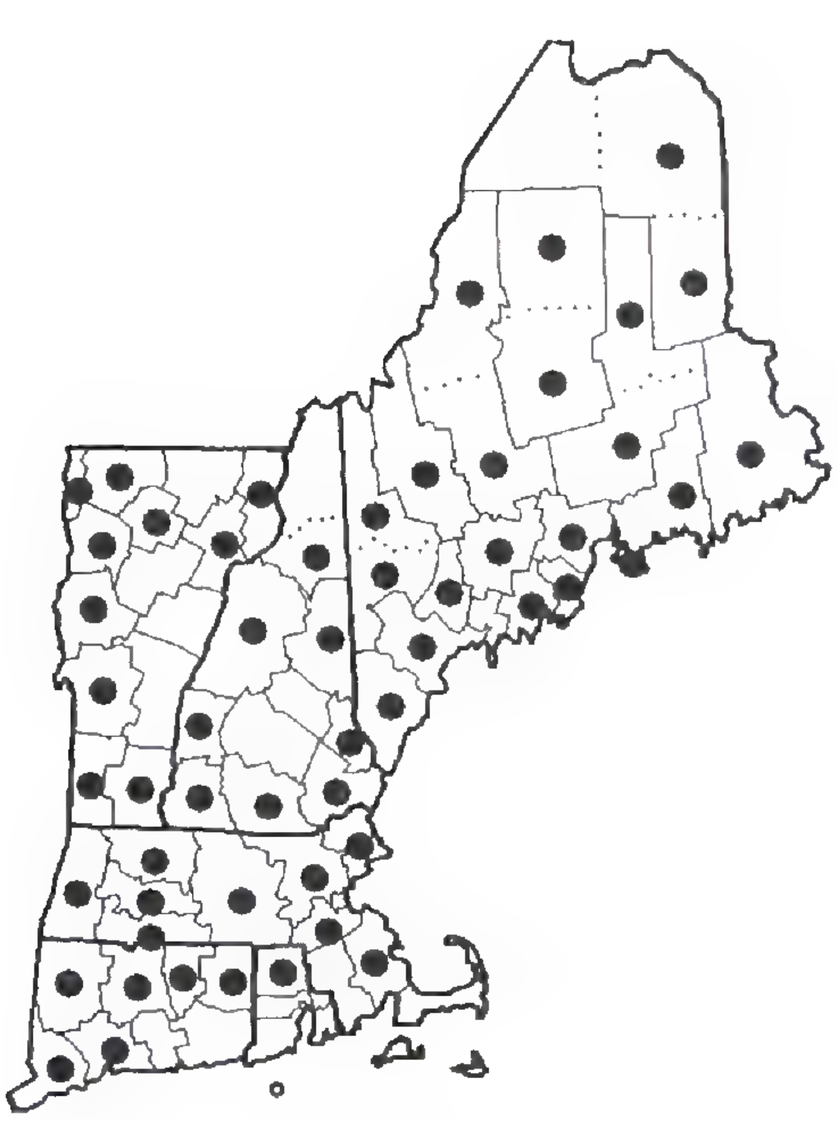
Figure 40. Distribution maps for *Thuja occidentalis*, *Abies balsamea*, *LARIX DECIDUA*, and *L. laricina*.



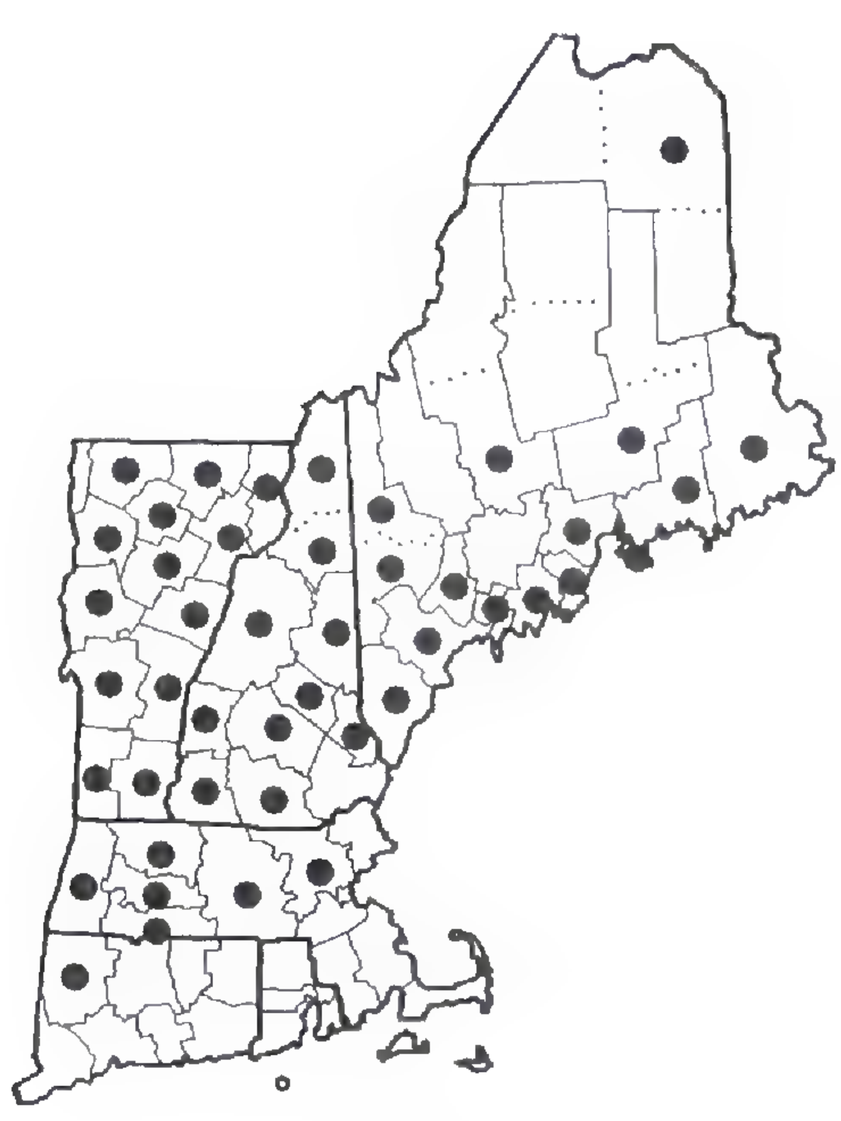
PICEA ABIES



Picea glauca

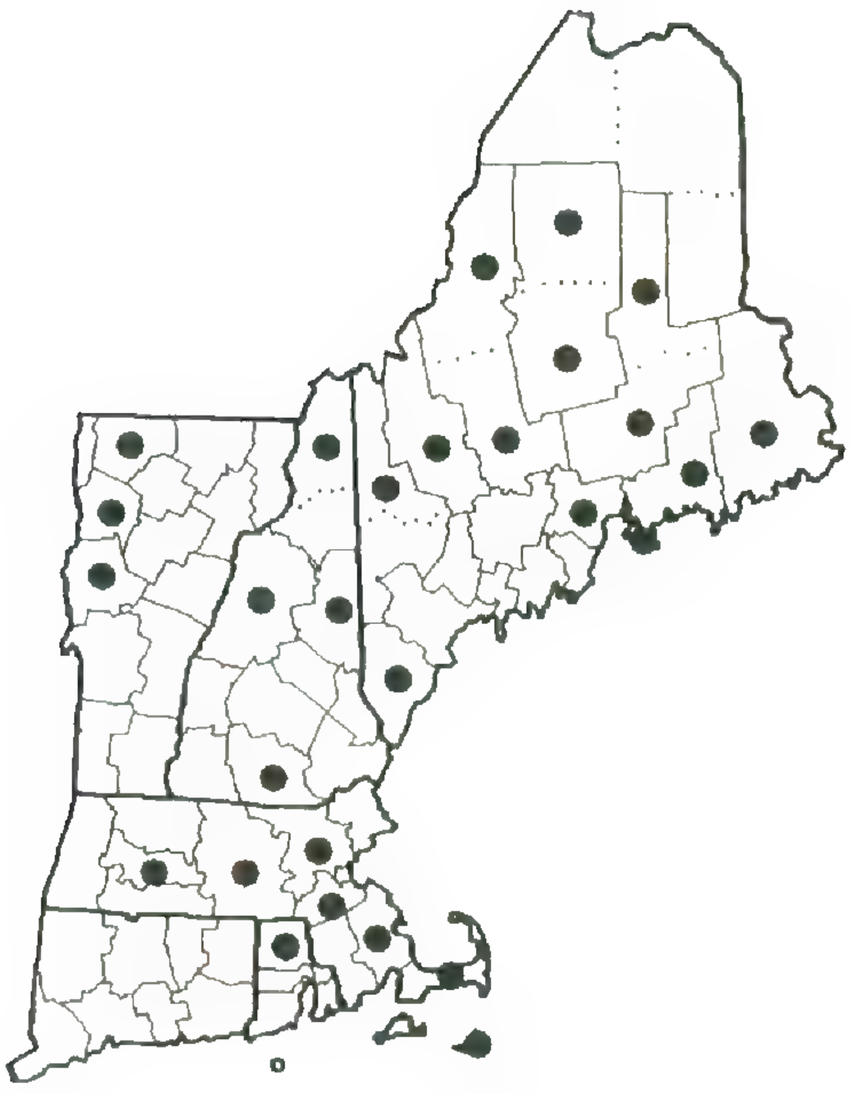


Picea mariana

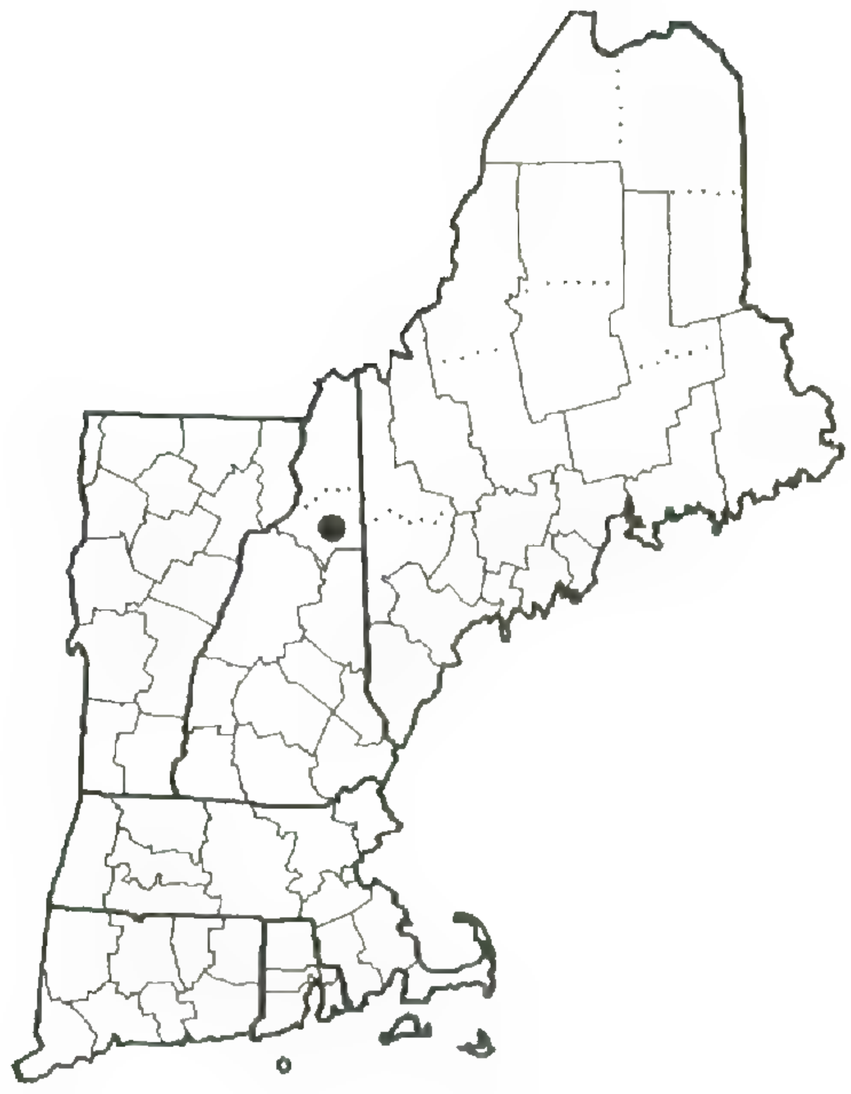


Picea rubens

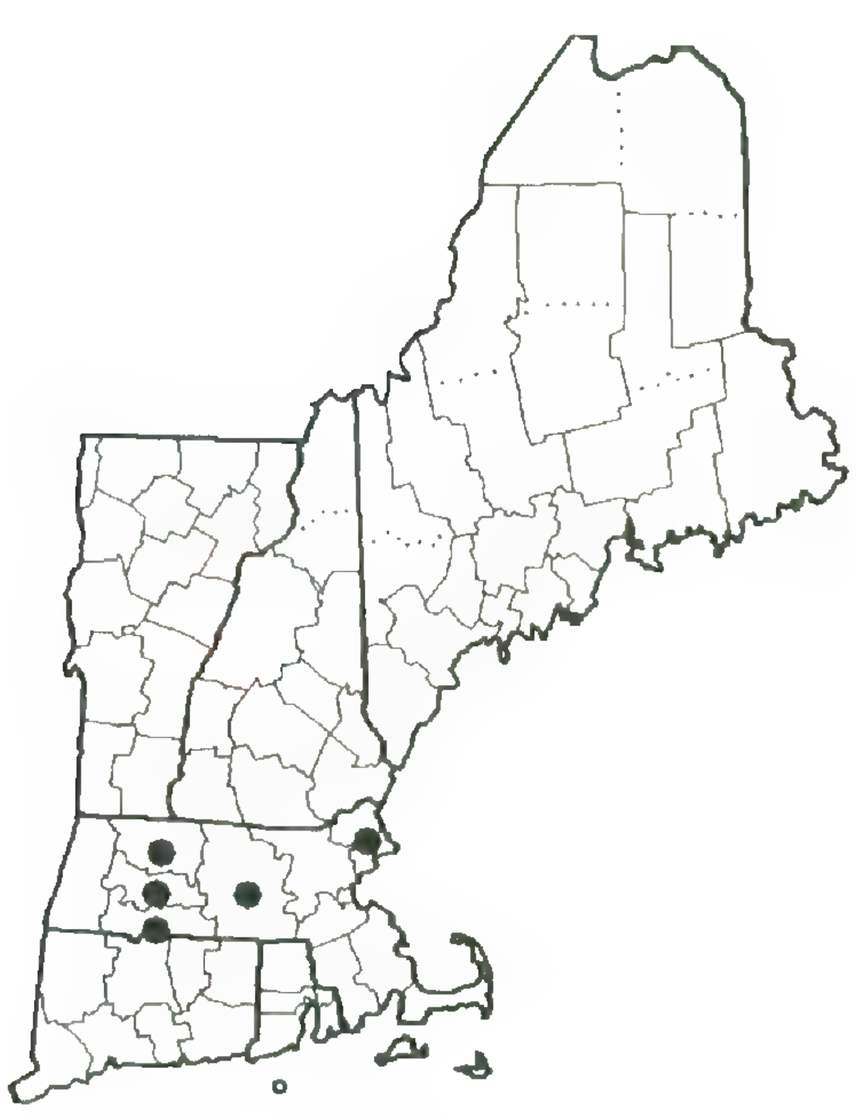
Figure 41. Distribution maps for *PICEA ABIES*, *P. glauca*, *P. mariana*, and *P. rubens*.



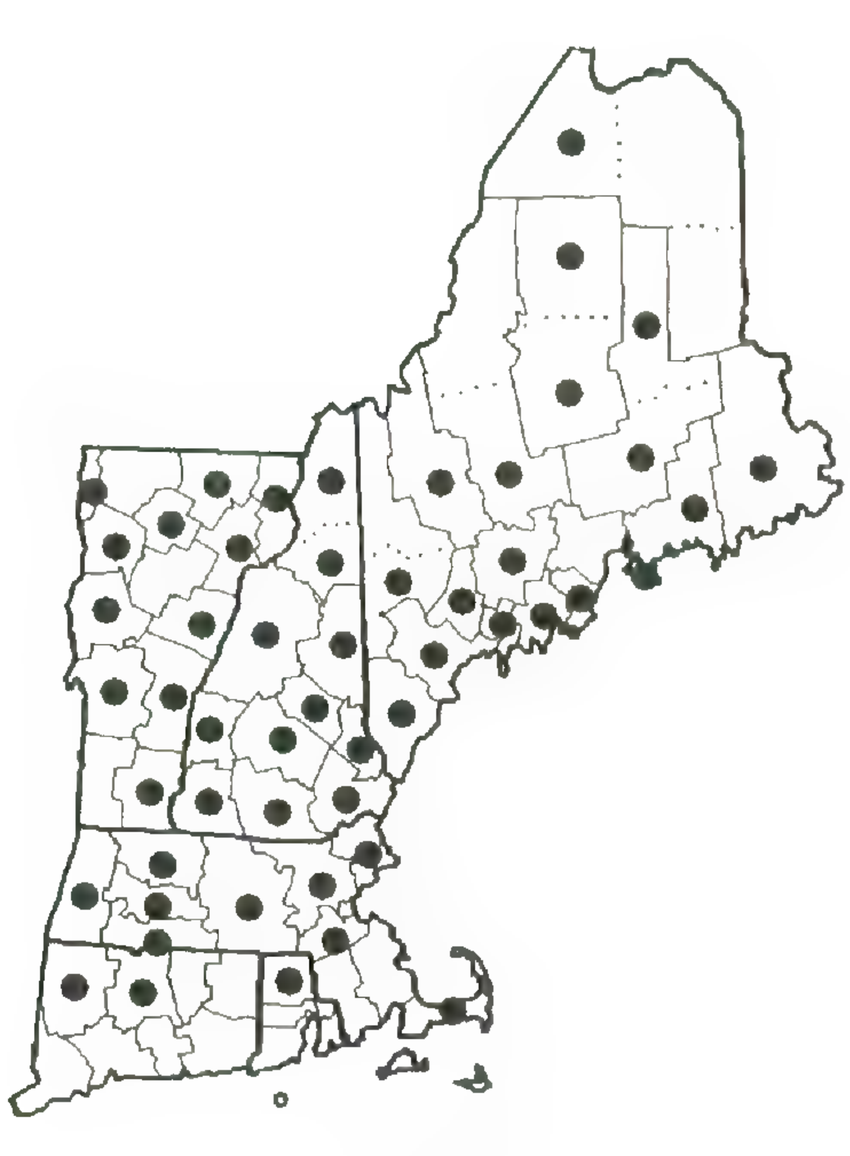
Pinus banksiana



PINUS MUGO

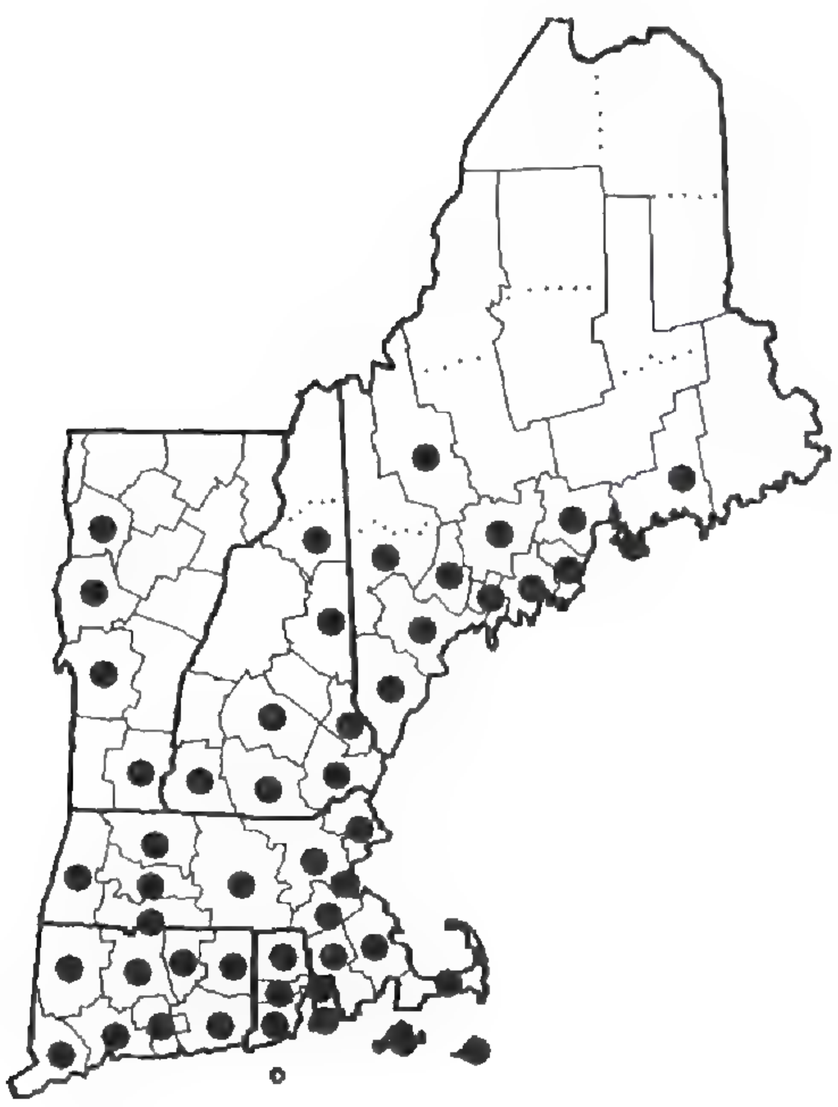


PINUS NIGRA

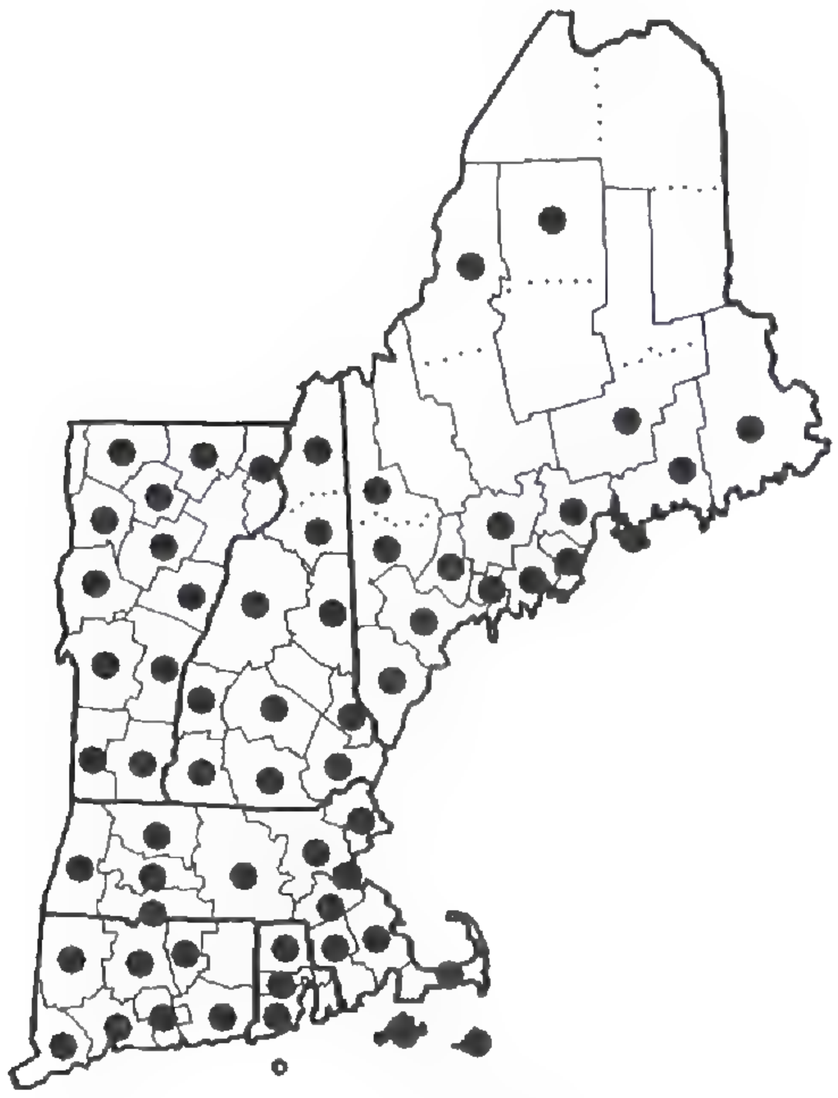


Pinus resinosa

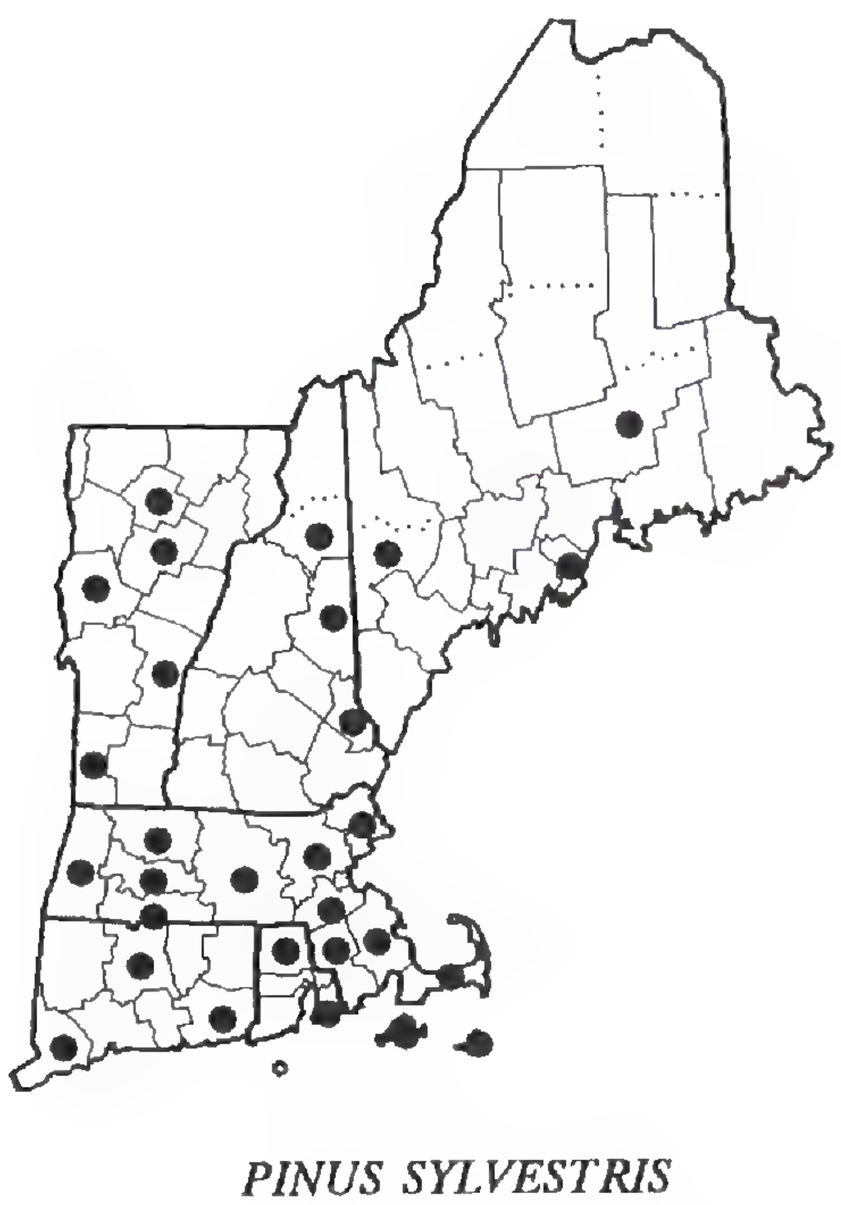
Figure 42. Distribution maps for *Pinus banksiana*, *P. MUGO*, *P. NIGRA*, and *P. resinosa*.



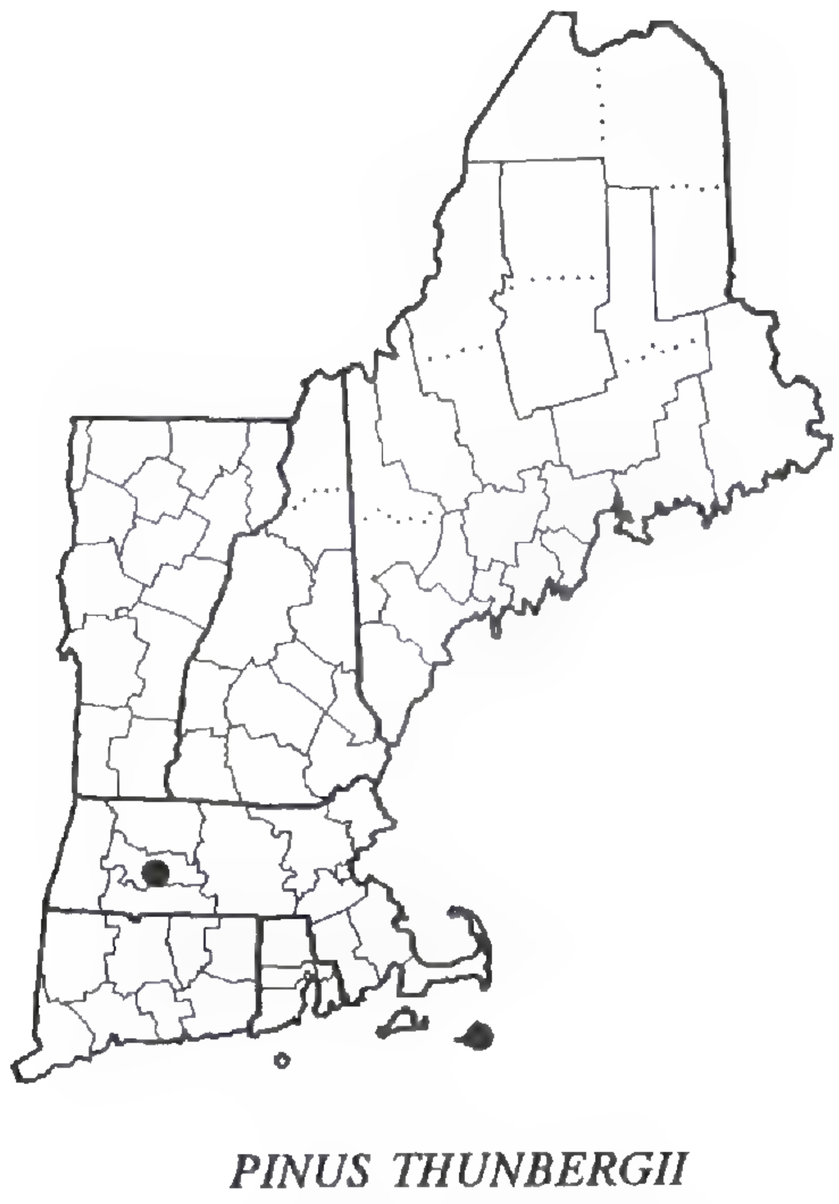
Pinus rigida



Pinus strobus

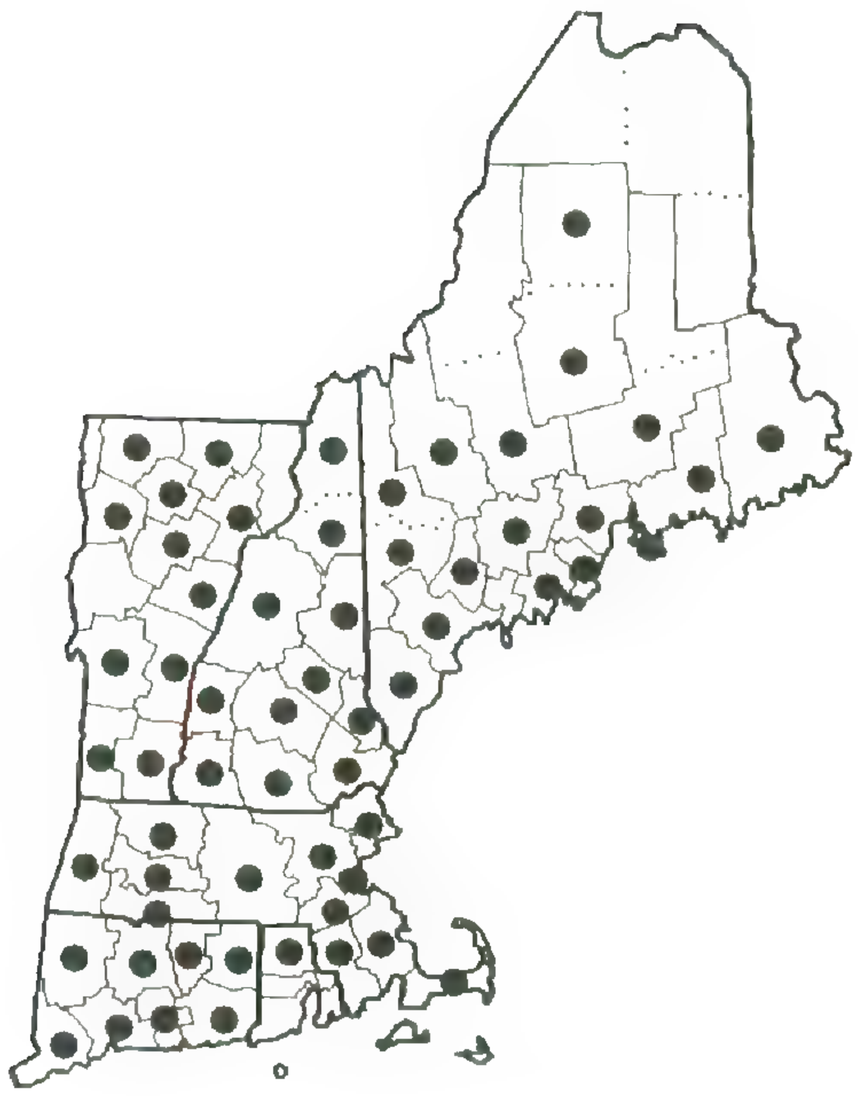


PINUS SYLVESTRIS

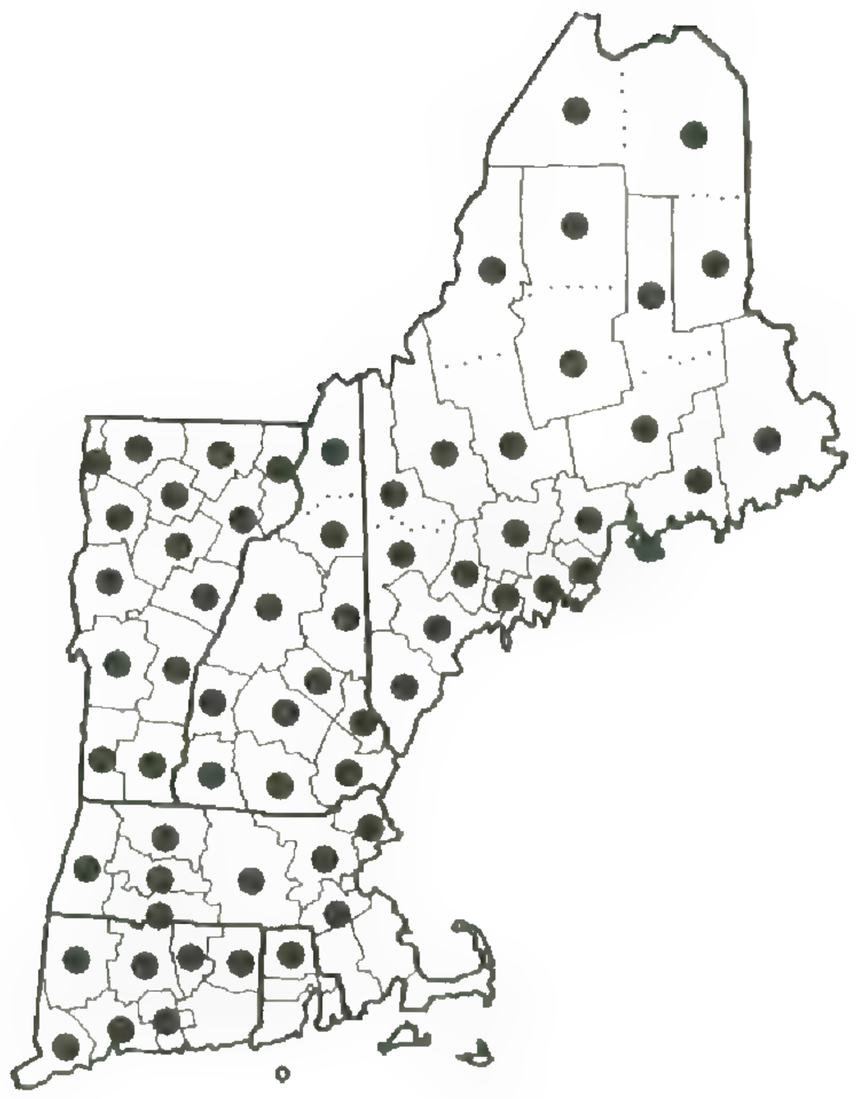


PINUS THUNBERGII

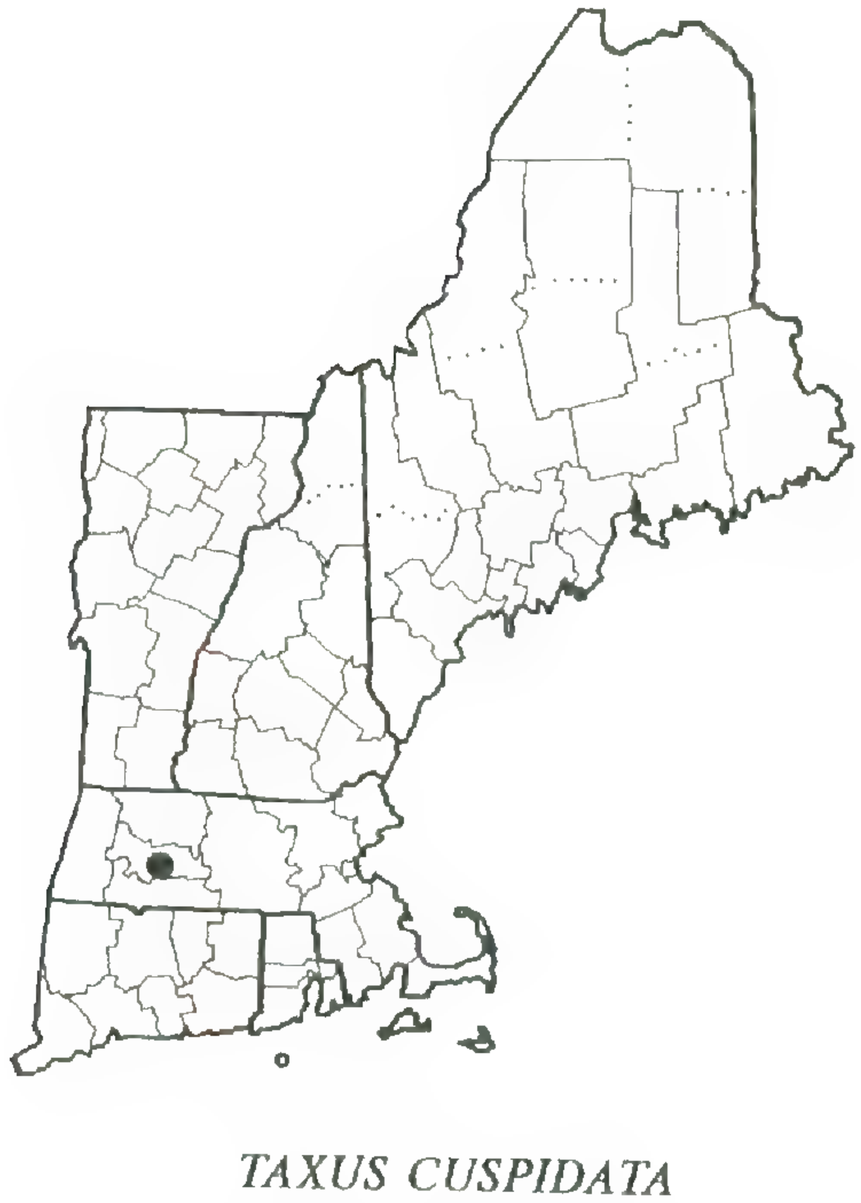
Figure 43. Distribution maps for *Pinus rigida*, *P. strobus*, *P. SYLVESTRIS*, and *P. THUNBERGII*.



Tsuga canadensis



Taxus canadensis



TAXUS CUSPIDATA

Figure 44. Distribution maps for *Tsuga canadensis*, *Taxus canadensis*, and *T. CUSPIDATA*.

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RHODORA, Vol. 98, No. 893, pp. 80–84, 1996

FIRST REPORT OF *UNCINIA MACROLEPIS* AND *U. TENUIS* (CYPERACEAE) IN COLOMBIA AND NEW COLOMBIAN SITES FOR *U. PALUDOSA*

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ABSTRACT. *Uncinia macrolepis* and *U. tenuis* are reported for the first time from Colombia. Additionally, four new Colombian sites are recorded for *U. paludosa*, previously known from only a single site in the country. A key to the five *Uncinia* species known to occur in Colombia is provided.

Key Words: Colombia, Cyperaceae, *Uncinia macrolepis*, *U. paludosa*, *U. tenuis*

The genus *Uncinia* Pers. (Cyperaceae), with some 60 to 70 species worldwide, is well represented in South America, with between 20 and 30 growing in the mountains and cooler regions of the continent (Wheeler and Goetghebeur 1995). Of these, *Uncinia hamata* (Sw.) Urban and *U. phleoides* (Cav.) Pers. have long been known from Colombia (Kükenthal 1909; Mora-Osejo 1966). More recently, *U. paludosa* G. A. Wheeler and Goetghebeur, well known from Ecuador, has been reported from a single Colombian site (Wheeler and Goetghebeur 1995).

While working on a revision of the *Uncinia* of Ecuador (Wheeler and Goetghebeur, in manuscript), many specimens from Colombia also were examined, some of which form the basis of this note. In this paper, two species of *Uncinia*, *U. macrolepis* Decne. and *U. tenuis* Poeppig ex Kunth, are reported for the first time from Colombia and four new Colombian sites are recorded for *U. paludosa*. A key to the five *Uncinia* species known to occur in Colombia is provided at the end of this report.

Uncinia macrolepis Decaisne in Dumont D'Urville, Voy. Pôle Sud 2: 13. 1853.

This species has a wide and rather remarkable distribution, occurring in northern South America, in Patagonia and Tierra del Fuego, and on the south-Atlantic islands of South Georgia and Tristan da Cunha (Wheeler 1994, 1995). In northern South America, specimens have been seen from Ecuador, Peru, and Venezuela; also, single specimens have been seen from Bolivia (*Beck*

21803 [MIN]) and Colombia (specimen cited below). The northern plants previously had been called *U. meridensis* Steyerm., whose type comes from Venezuela (Steyermark 1951), and Hooper (1968) considered similar-appearing plants from South Georgia (originally called *U. smithii* Philcox) and Tristan da Cunha to be conspecific with *U. meridensis*. In a separate paper (Wheeler 1995), however, it was demonstrated that the populations from northern South America, South Georgia, and Tristan da Cunha are morphologically indistinct from the Patagonian-Fuegian populations of *U. macrolepis*, whose name has priority.

In northern South America *Uncinia macrolepis* occurs near the upper limit of páramo, at elevations between 4000 and 4600 m (Wheeler and Goetghebeur, in manuscript). In Colombia, the single known locality for this species is at Alto Ritacuva in the Sierra Nevada del Cocuy, in the Department of Boyacá, where it grows at about 4550 m. At this site the species is common "between rocks on high slopes" and frequently is embedded in cushion plants. Because some páramo uncinias tend to look very similar, some Colombian specimens originally identified as *U. macrolepis* (as *U. meridensis*) actually are referable to *U. paludosa* (for more details and citation of specimens see under that species further below). Although similar in aspect, *U. macrolepis* and *U. paludosa* differ in several morphological features, and, in fact, are in different sections of the genus, with the former in section *Uncinia* and the latter in section *Platyandrae* C. B. Clarke (*sensu* Clarke 1883 and Kükenthal 1909). In addition to the differences given in the key, the style base of *U. macrolepis* is conspicuously enlarged, whereas that of *U. paludosa* is little thickened.

Colombia. Dpto. BOYACÁ: Cordillera Oriental, Sierra Nevada del Cocuy; Alto Ritacuva; alt. 4550 m, 11–29 Apr 1959, *Barclay & Juajibioy 7449* (US).

Uncinia paludosa G. A. Wheeler & Goetghebeur, Aliso 14: 142. 1995.

This species occurs in northern South America, with many sites known from Ecuador (Wheeler and Goetghebeur 1995, in manuscript), five from Colombia (specimens cited below), and a single one from Peru (*León and Young 1663* [NY]). In Colombia, it occurs in páramo, at elevations from about 3500 to 4000 m, growing primarily in bogs and swamps dominated by low shrubs and

herbs, such as *Chusquea* sp., *Espeletia lopezii*, and *Oritrophium limnophilium*.

Uncinia paludosa (sect. *Platyandrae*) appears to be closely related to *U. lacustris* G. A. Wheeler, thus far known only from Ecuador, but differs by having wider leaves, longer rachillae, and slightly larger perigynia and achenes (Wheeler and Goetghebeur 1995; see Figures 2 and 3 for a comparison of the two species). It also is related to *U. macloviana* Gaudich., which grows in Patagonia and on the Falkland Islands (Wheeler 1994), but differs by having smaller perigynia and achenes and pistillate scales that are about equal to or slightly exceed the perigynia.

As mentioned earlier, all of the specimens cited below originally were identified as *Uncinia meridensis* (here called *U. macrolepis*), but they actually are referable to *U. paludosa*. For differences between these two species, see the key and the discussion under *U. macrolepis*.

Colombia. Dpto. ARAUCA. Sierra Nevada del Cocuy. Quebrada El Playón: Hoya S. Luis, 1 km al N de la finca El Playón, alt. 3500 m, 13 Mar 1973, *Cleef 9153* (NY, U); Plan de S. José, alt. 3625 m, 9 Jun 1973, *Cleef 10057* (GB, NY, U).—Dpto. BOYACÁ: páramos al NW de Belén, cabaceras Quebrada Minas, Hoya Clla. Larga, alt. 3775 m, 2 Mar 1972, *Cleef 2092* (NY, U); Sierra Nevada del Cocuy, Alto Valle Lagunillas, NNE de la Laguna Pintada, alt. 3980 m, 3 Oct 1972, *Cleef 5782* (NY, U); Páramo de la Rusia, NW-N de Duitamo, Peña Blanca, 2 km al NE de Buenos Aires, alt. 3720 m, 16 Dec 1972, *Cleef 7318* (NY, U).

Uncinia tenuis Poeppig ex Kunth, Enum. Pl. 2: 525. 1837.

This species ranges from Tierra del Fuego (Wheeler 1994) northward to west-central Argentina (Barros 1969) and central Chile (Marticorena and Quezada 1985; Muñoz-Schick 1980) and is disjunct on the Juan Fernández Islands (Skottsberg 1922); further north it occurs in Ecuador (Wheeler and Goetghebeur, in manuscript) and is also reported from Costa Rica in Central America (Chater 1994). In Colombia, a single locality for this species is known from the summit of Quindío Pass, near the Caldas-Tolima boundary, where it grows on a "wind-beaten, bushy, wet crest" at about 3500 m.

Uncinia tenuis occurs primarily in forests and thickets, where it grows in loose mats in moist soil and also epiphytically on decaying, fallen trees. It is separated readily from the other Colombian uncinias by having glabrous perigynia and deciduous scales. Also, the inflorescence axes of this species, even when greatly

(or entirely) divested of perigynia, are identified easily by the presence of whitish or pale brown saccate appendages (about 1 mm long), which are the persistent portions of otherwise deciduous scales (Wheeler 1994). Notably, there are only two South American uncinias with deciduous scales and persistent saccate appendages, *U. tenuis* and *U. subsacculata* G. A. Wheeler and Goetghebeur, but the latter has shorter appendages (less than 0.5 mm long) and, thus far, is known only from the type locality in Ecuador (Wheeler and Goetghebeur 1995).

Colombia. Dpto. CALDAS–TOLIMA boundary: summit of Quindío Pass, 04° 28′ N. lat., 75° 37′ W. long., alt. 3500 m, 29 Nov 1944, *Fosberg 22389b* (US).

A KEY TO THE *UNCINIA* SPECIES OF COLOMBIA

1. Perigynia glabrous; pistillate scales deciduous (however, saccate appendages about 1 mm long persist); filaments narrow (ca. 0.1 mm wide); plants rhizomatous ..... *U. tenuis*
1. Perigynia slightly to densely pubescent, the margins ciliate (at least distally); pistillate scales persistent; filaments wide (ca. 0.2–0.3 mm) or narrow; plants cespitose or rhizomatous ..... (2)
    2. Spikes less than 2.5 cm long, with fewer than 20 perigynia per spike; filaments narrower than the anthers; culms frequently scabrous beneath the inflorescence ..... *U. macrolepis*
    2. Spikes 2.5 cm long or longer, with more than 20 perigynia per spike; filaments as wide as anthers; culms usually smooth beneath the inflorescence ..... (3)
        3. Longest perigynia more than 6.5 mm; achenes narrowly oblong; spikes thickish, clavate (or sometimes subclavate); robust plants up to 1.2 m tall ..... *U. phleoides*
        3. Perigynia less than 6.5 mm long; achenes not narrowly oblong; spikes linear or subclavate; plants short or tall ..... (4)
            4. Achenes more than 3 mm long; rachilla often bent just beneath the hook; spikes subclavate; leaves flaccid, some cauline ..... *U. hamata*
            4. Achenes less than 3 mm long; rachilla straight or nearly so; spikes linear; leaves rigid and mostly ascending, usually all basal ..... *U. paludosa*

ACKNOWLEDGMENTS. I thank Paul Goetghebeur (Gent University, Belgium) for correspondence regarding *Uncinia* and for information on the Colombian specimens of *U. paludosa* at the

Utrecht Herbarium (U), The Netherlands. Thanks also to the curators and directors of the following herbaria for the loan (or in-house study) of specimens from northern South America: AAU, F, G, GB, K, LD, MICH, MIN, MO, NY, P, QCA, US, and WIS.

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RHODORA, Vol. 98, No. 893, pp. 85–93, 1996

THE *PARALYCHNOPHORA* GROUP OF *EREMANTHUS* (VERNONIEAE: ASTERACEAE)

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ABSTRACT. The species placed in *Paralychnophora* by MacLeish are returned to the genus *Eremanthus*, and two related species, *E. harleyi* and *E. santosii*, are described as new.

Key Words: Asteraceae, Compositae, Vernonieae, *Eremanthus*, *Paralychnophora*

Extensive work has been done on *Eremanthus* Less. and its relatives during the last 20 years. Some genera such as *Chresta* Vell. ex DC. (Robinson 1980) and *Paralychnophora* MacLeish (MacLeish 1984) have been removed from *Eremanthus*. One traditional genus, *Vanillosmopsis* Sch. Bip., has been placed in the synonymy of *Eremanthus* (MacLeish 1987). Recent authors still do not agree completely on all the generic limits. In two genera, *Eremanthus* and *Chresta*, the concepts of the present author remain more inclusive than those of MacLeish (1984, 1985a, b, 1987). The group treated in the present paper, *Paralychnophora*, is regarded by the present author as part of *Eremanthus*. MacLeish (1987) states that *Paralychnophora* is like *Lychnophora* in having a biseriate pappus and glomerules that are derived from the internode reduction of corymbose subglomerules. She distinguishes *Paralychnophora* on the basis of axillary, solitary glomerules and angled achenes. Of these features, only the rather solitary nature of the glomerules of heads, a feature noted by Baker (1873), can be used to distinguish the group from the broad concept of *Eremanthus*.

The present study of the *Paralychnophora* group has considered the generic problem, but it concerns problems mostly at the species level. As a result of the study, an unvalidated Glaziou name, *Eremanthus schwackei*, is placed in synonymy and two new species, *E. harleyi* and *E. santosii*, are described. The records of the names and synonyms are needed for a listing being prepared of all known Vernonieae of the Western Hemisphere.

Paralychnophora was a nom. nov. by MacLeish (1984) for *Sphaerophora* Sch. Bip., Jahresber. Pollichia 20–21: 402. 1863, non *Sphaerophora* Blume, 1850 (Rubiaceae). The type of *Para-*

lychnophora, *P. bicolor* (DC.) MacLeish, and two other species were included in *Paralychnophora* by MacLeish. All had been treated previously as *Eremanthus*. An initial problem was noticed in this study in *Eremanthus* (*Paralychnophora*) *schwackei*, a Glaziou species, that was recognized as distinct by MacLeish (1987), but which never has been validated. The proposed combination by MacLeish did not validate the species. In spite of the initial concern, the present study has shown that there now is no need to validate the Glaziou name. Instead, *E. bicolor* needs to be redefined, and two new species need to be distinguished and described. A listing also can be provided of specimens of *Eremanthus reflexo-auriculatus* Barroso that previously have been identified as *E. bicolor*.

The four species of the *Paralychnophora* group of *Eremanthus* can be distinguished by the following key.

1. Leaf blades with depressed areoles on upper surface; fertile branches with subopposite or opposite median bracts; corolla lobes with few hairs not extending beyond tips of lobes ... 1. *E. bicolor*
1. Leaf blades with weakly bullate or rugulose upper surfaces; fertile branches with strictly alternate bracts; corolla lobes with dense hairs distally, some extending beyond tips of lobes ..... (2)
   2. Individual heads with 2 or 3 florets; leaf blades oblanceolate with narrowly cuneate bases ..... 2. *E. santosii*
   2. Individual heads with 5–9 florets; leaf blades oblong to obovate with shortly acute to auriculate bases ..... (3)
      3. Bases of leaf blades auriculate, often clasping the stem ..... 4. *E. reflexo-auriculatus*
      3. Bases of leaf blades obtuse to shortly acute, distinctly petiolate ..... 3. *E. harleyi*

1. **Eremanthus bicolor** (DC.) Baker in Mart., Fl. brasil. 6(2): 165. 1873. (Figure 1)

Albertinia bicolor DC., Prodr. 5: 81. 1836.
Sphaerophora bicolor (DC.) Sch. Bip., Jahresber. Pollichia 20–21: 402. 1863.
Eremanthus schwackei Glaziou, Bull. Soc. Bot. France 3: 380. 1909, *nom. nud.*
Paralychnophora bicolor (DC.) MacLeish, Taxon 33: 106. 1984.
Paralychnophora schwackei (Glaziou) MacLeish, Taxon 33: 106. 1984, *nom. nud.*

Shrubs or trees 1.5–5.0 m tall, moderately branched; stems terete, usually grayish velutinous, distal internodes 0.3–1.0 cm long. Leaves alternate, petioles 0.5–1.8 cm long; blades oblong-

elliptical, 5–19 cm long, 3–6 cm wide, base rounded to attenuate, margins entire, apex rounded, upper surface minutely alveolate when dry, 9–15 secondary veins on each side. Inflorescences on long, ascending branches from upper leaf axils, branches with reduced, easily deciduous bracts, median bracts usually subopposite or opposite. Inflorescences becoming spherical when mature, 2.5–5.0 cm in diameter. Heads sessile; involucral bracts, in ca. 3 subequal series, linear, to 5 mm long, with reflexed, white-tomentose tips. Florets 2–4 in a head; corollas violet, ca. 7 mm long, tube 3–4 mm long, throat nearly lacking, lobes ca. 3 mm long, erect, with few hairs distally not extending beyond lobe tip, with numerous glands. Achenes ca. 3 mm long, glabrous, with idioblasts on surface; inner pappus bristles ca. 4.5 mm long, with slightly but distinctly broadened tips, outer pappus elements narrowly linear, ca. 1.5 mm long. Pollen ca. 45 μm in diameter.

Brazil. MINAS GERAIS: on sandstone outcrop ca. 3–5 km east of Serra, road to Diamantina, 9 Aug 1960, *Maguire, Magalhaes & Maguire 49119* (NY, US); slopes and summit of Serra Grão Mogul, 900–1100 m, frequent, on sandstone, 17 Aug 1960, *Maguire, Magalhaes & Maguire 49247* (NY, US); Serra do Espinhaço, ca. 18 km E of Diamantina, elev. 1100 m, rocky summits with soil-filled crevices and small areas of white sand, 19 Mar 1970, *Irwin, Fonsêca, Souza, Reis dos Santos & Ramos 27887* (NY, UB, US); ca. 35 km SW of Gouveia, km 243 on M.G. 259, 1080 m, very rocky sandstone hilltops with occasional wet spots, 2 Feb 1972, *Anderson, Stieber & Kirkbride 35116* (NY, UB, US); Ribeirão (mun. Grão Mogol), dos paredões rochosos na beira do corrego, 23 Apr 1978, *Hatschbach 41421* (MBM, US); between Mendanha and Diamantina, 10 km NE of Diamantina on Estrada 367, campo rupestre, 4 Oct 1980, *MacLeish, Ferreira, Smith & Stutts 701* (GA, US); Grão Mogol, subida para Pasto, campo rupestre, encosta de morro junto a afloramentos rochosos, 17 May 1988, *Hatschbach & Ribas 52102* (MBM, US); Penha da França, ca. de 100 km ao nordeste de Diamantina, 18°5′S 43°5′O, ca. 1000 m, 11 Mar 1995, *Splett 868* (BONN, UB, US).

Glaziou (1909) named the plant the same way he named many others, indicating locality, "Diamantina," habit, "arbusto," and flower color, lilac. Such names have been regarded as nom. nud. by recent authors, and such species are accepted only after validation by later authors. No such validation has occurred for the Glaziou name, and now it seems that such validation is not necessary.

Material annotated as *Eremanthus schwackei* was distinct from extensive material from Bahia recently determined as *E. bicolor.* However, the types of both *E. schwackei* and *E. bicolor* are from Minas Gerais, and the original description (Candolle 1836) and subsequent critical description (Baker 1873) of *E. bicolor* state

that there are 2 or 3 florets in a head, indicating that *E. bicolor* and *E. schwackei* are the same species. It is the extensive material determined as *E. bicolor* from Bahia that needs to be placed in other species, including two that are new. The material determined as *E. schwackei* seems to differ from more typical *E. bicolor* only by the somewhat shorter, oblong leaves that are 5–12 vs. 11–19 cm long. One of the most distinctive features of the combined concept of *E. bicolor* and *E. schwackei* is the elongate, ascending inflorescence branches. The branches are particularly noticeable after the bracts have fallen. The median bracts of the branches are few, and they seem to be opposite or subopposite. Other less obvious, but apparently useful differences are the regularly alveolate upper surface of the dried leaf and the limited pubescence of the corolla lobes. All other members of the *Paralychnophora* group have minutely bullate or rugulose upper leaf surfaces and longer and denser pubescence on the corolla lobes. The Bahia material previously named as *E. bicolor* or *E. schwackei* proves to belong to either *E. reflexo-auriculatus* Barroso or one of the two following new species.

2. **Eremanthus santosii** H. Robinson, *sp. nov.* TYPE: BRAZIL. Bahia: Santa Maria Eterna, 1 a 2 km de estrada a Canavieires, campo arenoso coberta de érvore e arbusto, 18 May 1970, *T.S. dos Santos 820* (HOLOTYPE: CEPEC; ISOTYPE: US). (Figure 2)

Plantae frutescentes 2.5–4.0 m altae leniter ramosae; internodes distales 0.5–2.0 cm longis. Folia in laminis oblanceolata ad 18 cm longa base cuneata margine saepe recurvata apice rotundata in nervis secundariis utrinque ca. 15. Inflorescentiae in ramis interdum elongatis ascendentibus dispositae, bracteis alternis; flores in capitulo 2 aut 3; corollae in lobis distaliter dense longe pilosae.

Shrubs 2.5–4.0 m high, sparsely branched; stems terete below, sulcate when dried young, usually yellowish-brown velutinous, distal internodes 0.5–2.0 cm long. Leaves alternate, petioles mostly 1.0–2.5 cm long; blades oblanceolate, 13–18 cm long, 4.0–4.5 cm wide, base narrowly cuneate, margins entire, often broadly recurved, with sides nearly parallel in distal half, apex rounded, upper surface minutely bullate or rugulose when dry, ca. 15 close-set, spreading secondary veins on each side. Inflorescences on long, ascending branches from upper leaf axils or with spreading branches from lower axils, branches with reduced, easily decidu-

ous bracts, all bracts alternate. Inflorescences becoming spherical when mature, 2.5–3.0 cm in diameter. Heads sessile; involucral bracts, in ca. 3 subequal series, linear, to 7 mm long, with reflexed, white-tomentose tips. Florets 2 or 3 in a head; corollas violet, ca. 7 mm long, tube ca. 3.5 mm long, throat nearly lacking, lobes ca. 3.5 mm long, erect, with many hairs distally, some extending beyond lobe tip, with numerous glands. Achenes ca. 3 mm long, glabrous, idioblasts not seen; inner pappus bristles ca. 5 mm long, slightly broadened from bases to tips, outer pappus elements linear to setiform 0.5–1.0 mm long. Pollen ca. 50 μm in diameter.

PARATYPES: **Brazil.** BAHIA: Mt. Peludo, *H. M. Curran 387* (US); Santa Maria Eterna km 1, a Canavieires, campo arenoso, 13 Aug 1971, *T. S. dos Santos 1812* (CEPEC, US); Serra do Sincorá, 3–13 km W of Barra da Estiva on road to Jussiape, 1000–1300 m, 13°40′S 41°25′W, low grassland with scattered woodland and small streams on white quartzite soils, growing on slope of sandstone ridge, 23 Mar 1980, *Harley, Bromley, Carvalho & Martinelli 20809* (CEPEC, K, US); município de Abaira, Campos de Ouro Fino, próximo a Serra dos Bicanos, 1650 m, 13°16′S 41°54′W, campo rupestre, entre rochas, 16 July 1992, *Wilson Ganev 671* (K, SPF, US).

Specimens of *Eremanthus santosii* have been identified as *Eremanthus bicolor* or as the synonymous *Paralychnophora schwackei* (Glaz.) MacLeish, which is identified here as *E. bicolor*. The new species includes specimens that have elongate, ascending inflorescence branches as in *E. bicolor*, and the two species share the characteristic of few-flowered heads. The first two specimens examined by this author initially seemed different from most specimens of *E. bicolor* because of the longer cuneate leaf bases. However, cuneate bases apparently occur in some specimens of *E. bicolor* (Baker 1873, pl. 45). The more important distinctions are the often less congested distal leaves with longer internodes, the slight difference in the bulging rather than depressed areoles on the upper surface of the leaves, the strictly alternate bracts on the inflorescence branches, and the presence of the larger, more numerous hairs on the corolla lobes. At present, *E. santosii* is known only from Bahia, while *E. bicolor* is known only from Minas Gerais. The leaves of the two dos Santos collections are pressed flat, but the leaves of the other three specimens show a strong tendency for the margins to recurve, a tendency noticed only in *E. reflexo-auriculatus* among other species of the group.

The new species is named for the collector of the type specimen, T. S. dos Santos of the Herbário Centro de Pesquisas do Cacau (CEPEC) in Ilhéus, Bahia.

3. **Eremanthus harleyi** H. Robinson, *sp. nov.* TYPE: BRAZIL. Bahia: Mun. Rio de Contas, Pico das Almas, Vertente leste, alto do vale acima da Faz, Silvina, 13°31′S 41°58′W, 1550 m, sobre rochas, 16 Dec 1988, *Harley 27255* (HOLOTYPE: CEPEC; ISOTYPES: K, SPF, US). (Figure 3)

Plantae frutescentes vel arborescentes 1–5 m altae; internodes distales 0.3–1.0 cm longis. Folia in laminis oblongo-elliptica plerumque 8–17 cm longa 3.5–8.0 cm lata base obtusa vel breviter acuta apice rotundata supra minute bullata vel rugulosa in nervis secundariis utrinque 6–12. Inflorescentiae saepe distincte laterales plerumque mediocriter vel late patentes, ramis brevibus vel mediocriter elongatis, bracteis alternis; flores in capitulo 5–9; corollae in lobis distaliter dense longe pilosae.

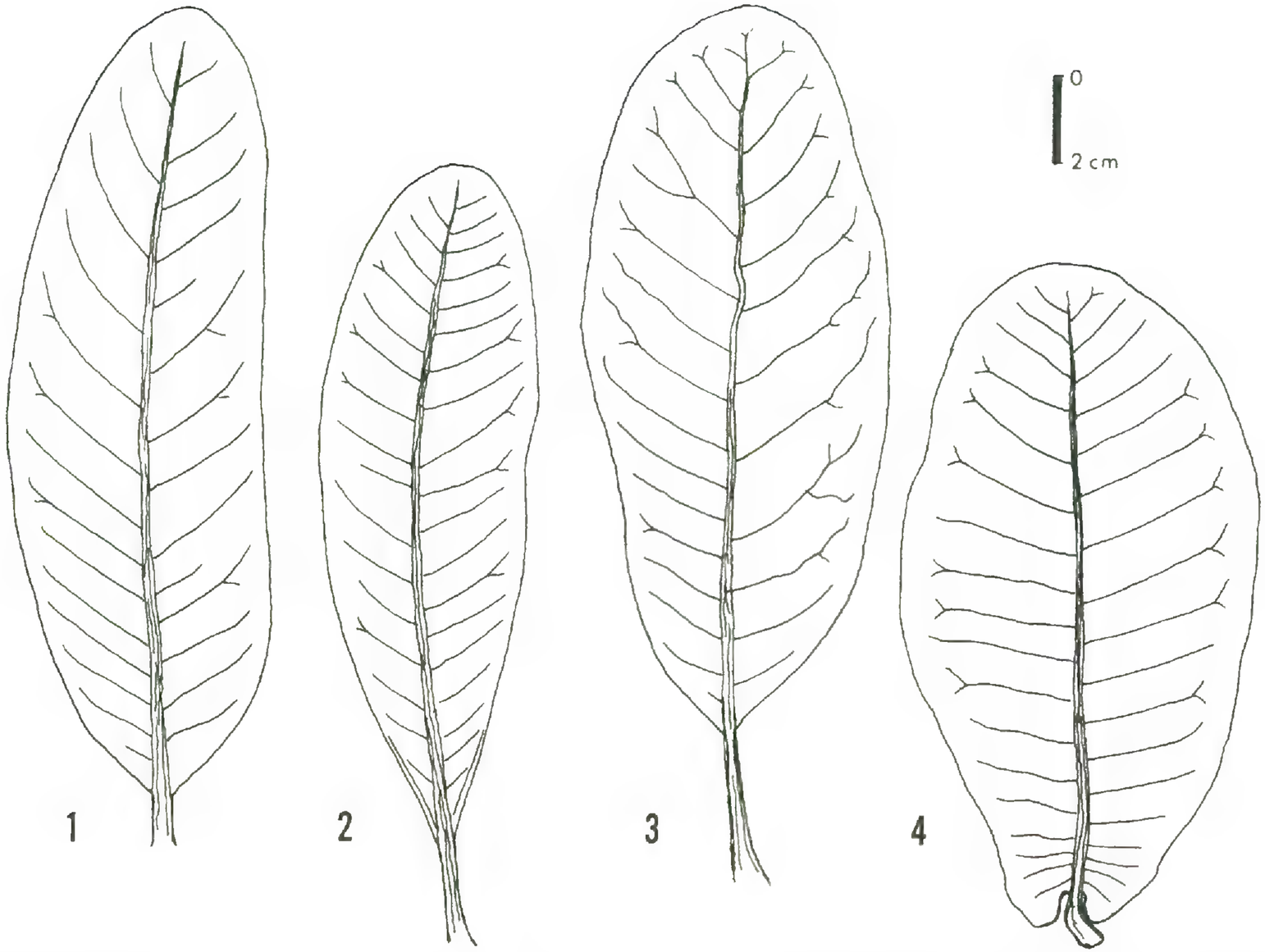
Shrubs to small trees 1.5–5.0 m high, moderately branched; trunks to 8 cm in diameter, terete below, young parts sulcate when dried, yellowish or brownish velutinous, internodes 0.5–2.5 cm long. Leaves alternate, petioles 1.0–3.5 cm long; blades oblong-ovate to elliptical, 8–17 cm long, 3.5–8.0 cm wide, base obtuse to shortly acute, margins entire, flat, apex rounded to obtuse, upper surface minutely bullate or rugulose, lower surface whitish to sordid tomentose, with prominent veins, with 6–12 secondary veins on each side of midrib, strongly arching distally. Inflorescence on short terminal peduncle or on spreading lateral branch mostly 8–15 cm long, bracteoles of branch alternate; inflorescence becoming spherical or subspherical when mature, 3.0–4.5 cm in diameter, with many lanceolate to elliptical foliose bracts at base, these 1–5 cm long. Heads sessile; involucral bracts in ca. 3 subequal series, linear, 5–7 mm long, densely white-tomentose outside. Florets 5–9 in a head; corollas rosaceous to violet, ca. 8.5 mm long, tube ca. 5 mm long, throat ca. 0.5 mm long, lobes ca. 3 mm long, with many hairs at tip, some extending beyond lobe tip, with numerous glands. Achenes ca. 3 mm long, glabrous, idioblasts not seen; pappus bristles ca. 7 mm long, slightly broadened from bases to tips, outer pappus elements setiform, 1–2 mm long, not broadened distally. Pollen ca. 48 μm in diameter.

PARATYPES: **Brazil.** BAHIA: Serra do Rio de Contas, 12–14 km N of town of Rio de Contas on road to Mato Grosso, ca. 1200 m, approx. 13°28′S 41°50′W, dry quartzite hillside with disturbed woodland on lower slopes and scrub above,

17 Jan 1974, *Harley, Renvoize, Erskine, Brighton & Pinheiro 15187* (CEPEC, K, US); Mun. de Rio de Contas, a 4 km ao NW de Rio de Contas, campo rupestre, ca. 1000 m, 21 July 1979, *King, Mori, T. S. dos Santos & Hage 8069* (CEPEC, US); base de Pico das Almas, a 18 km ao NW de Rio de Contas, ca. 1300 m, 24 July 1979, *King, Mori, T. S. dos Santos & Hage 8132* (CEPEC, US); Mun. de Mucugê, a 3 km ao S de Mucugê, na estrada que vai par Jussiape, ca. 1000 m, 26 July 1979, *King, Mori, T. S. dos Santos & Hage 8152* (CEPEC, US); Estrada que liga Mucugê com Andarai a 11 km de primeiro, ca. 1150 m, 27 July 1979, *King, Mori, T. S. dos Santos & Hage 8170* (CEPEC, US); Mun. Lençois, Serras dos Lençois, Serra do Brejão ca. 14 km NW of Lençois, western face of sandstone serra with horizontally bedded rocks, extensive grassland & marsh on lower slopes & small streams with low woodland, rock outcrops at high altitudes, with humid forest in rocky declivity below summit, 700–1000 m, 12°27′S 41°27′W, E6, 22 May 1980, *Harley, Bromley, Carvalho, Soares Nunes, Hage, & E. B. dos Santos 22335* (CEPEC, K, US); Vicinity of Pico das Almas, ca. 20 km NW of town of Rio de Contas, 3500–4600 ft., 25 Jan 1981, *King & Bishop 8668* (UB, US); 2 km along road S of Mucugê, 2600 ft., 31 Jan 1981, *King & Bishop 8712* (UB, US); 52 km E of Seabra, along road toward Itaberaba, 1900 ft., 2 Feb 1981, *King & Bishop 8774* (UB, US); Mun. of Lençois, along BR242, ca. 15 km NW of Lençois at km 225, ca. 900 m, campo rupestre, 10 June 1981, *Mori & Boom 14271* (NY, US); Estrada de Lençois BR242, 5 km ao N de Lençois, campo natural, 19 Dec 1981, *Carvalho, Lewis & Hage 1001* (CEPEC, US); Rio de Contas, arredores, campo rupestre, 17 May 1983, *Hatschbach 46552* (MBM, US); Mucugê, 5 km S, campo rupestre, solo arenoso, 22 Jan 1984, *Hatschbach 47486* (MBM, US); Mun. Piatã: Quebrada da Serra do Atalho, 13°13′S 41°50′W, 1600–1700 m, 26 Dec 1991, *Hind, Lughadha, Souza, Sakaragui e Ganev 50385* (CEPEC, HUEFS, K, SPF, US); Mun. de Abaíra, Belo Horizonte, acima do Jambreiro, próximo a Serra do Sumbaré, 13°18′S 41°52′W, 1350 m, campo rupestre com solo arenoso e grandes matações de rochas, 27 Oct 1992, *Ganev 1376* (HUEFS, K, SPF, US); Mun. Abaíra, Campo de Ouro Fino (alto), 13°15′S 41°54′W, 1700–1800 m, em capoeira e sobre e entre rochas na encosta do morro, 17 Jan 1992, *Hind & Queiroz 50071* (CEPEC, HUEFS, K, SPF, US).

Eremanthus harleyi includes the bulk of the material that has been identified in recent years as *E. bicolor* from Bahia. The present study has shown that true *E. bicolor* is mostly, if not totally, restricted to Minas Gerais and differs in having fewer florets in the heads, a different upper leaf surface, more closely set secondary veins of the leaf, opposite or subopposite median bracts on the inflorescence branches, and fewer, shorter hairs on the lobes of the corollas. *Eremanthus harleyi* is more closely related to *E. reflexo-auriculatus*, which also occurs in Bahia, but the latter differs in having the strong basal auricles on the leaf blade, the often strongly recurved leaf margins, and the foliose bracts at the base of the inflorescences that are more broadly ovate.

The species is named for Ray M. Harley of Kew, the collector of the type specimen and a specialist in the Lamiaceae, who has organized a number of trips to collect Bahian specimens.



Figures 1–4. Leaves of *Eremanthus* spp. 1. *E. bicolor* (*Hatschbach 52102*, US). 2. *E. santosii* (*Ganev 671*, US). 3. *E. harleyi* (*Mori & Boom 14271*, US). 4. *E. reflexo-auriculatus* (*Harley 22766*, US). Scale bar = 2 cm.

4. **Eremanthus reflexo-auriculatus** Barroso, Rodriguésia 35–36: 6. 1960–61 [1962]. (Figure 4)

Paralychnophora reflexo-auriculata (Barroso) MacLeish, Taxon 33(1): 106. 1984.

The species originally was described from Pernambuco (Barroso, 1960–1) to accommodate a specimen differing from *Eremanthus bicolor* in having strongly auriculate bases of the leaf blades. The leaf blades also commonly have broadly recurved margins. The species seems to be closely related to *E. harleyi*, which shares the shorter, usually more spreading branches and the 6–9-flowered heads, but the series of specimens seen from Bahia shows a consistent difference in the leaf base.

The following specimens of *Eremanthus reflexo-auriculatus* have been extracted from material in the U.S. National Herbarium previously identified as *E. bicolor*.

Brazil. BAHIA: Serra do Tombador, 20 Feb 1971, *Irwin, Harley & Smith 30689* (NY, US); Munic. Morro do Chapeu, 30–31 May 1980, *Harley, Bromley, de Carvalho, Soares Nunes, Hage & E. B. dos Santos 22766, 22867* (CEPEC, K, US); Morro do Chapeu, 16 June 1981, *Mori & Boom 14446* (NY, US); Munic. Jacobina, Serra do Tombador, ca. 25 km na estrada Jacobina/Morro do Chapéu, 20 Feb 1993, *Carvalho, Amorin & Jardim 4177* (CEPEC, US).

ACKNOWLEDGMENTS. John Pruski, of the Smithsonian Department of Botany, is thanked for many helpful suggestions.

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RHODORA, Vol. 98, No. 893, pp. 94–98, 1996

NEW ENGLAND NOTE

A FLORA OF THE VASCULAR AND NON-VASCULAR PLANTS OF NANTUCKET, TUCKERNUCK, AND MUSKEGET ISLANDS

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Nantucket has been recognized widely as a botanical "hotspot" with one of the greatest concentrations of rare species in Massachusetts. A host of well-known 19th century botanists forayed on the island in search of unusual material. Many of their collections still are intriguing. The first recorded plant specimen from Nantucket dates from 1827, when Thomas A. Greene of New Bedford made a collection of slender marsh-pink (*Sabatia campanulata*) from the island. Two years later, James W. Robbins (of *Potentilla robbinsiana* fame) made a second collection of the same species from Greene's site "in moist hollows in Squam." Interest in this species continues to be keen as it is known in Massachusetts only from two sites on Cape Cod and Nantucket. It was to be the first in a long line of notable records to come from Nantucket. Another of the early collections made on the island was seabeach amaranth (*Amaranthus pumilus*), collected by S. T. Olney in 1849. It has not been seen again in the state.

In 1888, Maria Owen published a flora of the island that included over 600 species. Her list was by no means definitive, but it was one of the first floras published for any county in Massachusetts. Eugene P. Bicknell produced the most definitive work on the Nantucket flora with his "Ferns and Flowering Plants of Nantucket," published in a series of installments between 1908 and 1919 in the *Bulletin of the Torrey Botanical Club*. Now, nearly eight decades later, we have compiled a comprehensive flora that builds upon the work of these earlier botanists (Sorrie and Dunwiddie 1996; Dunwiddie and Sorrie 1996).

Our flora is somewhat broader both geographically and taxonomically than earlier works. In addition to the island of Nantucket, we have included records from the other two vegetated islands in Nantucket County, Muskeget and Tuckernuck. Our work also includes lichens, mosses, and other bryophyte records. The published flora includes common and scientific names and synonymy for each species, as well as habitat and abundance information, state ranks for rare species, data on origin (native versus introduced), and notations for potentially invasive species. The flora also is available in a computerized relational database. This database contains all of the above information, in addition to fields noting life form (tree, shrub, graminoid, etc.), duration (annual, biennial, or perennial), records of our own collections and sightings, and notations indicating which previous authors also reported a Nantucket occurrence for a species.

Our flora includes a total of 1265 vascular taxa, including species, varieties, subspecies, and hybrids. Thirty-nine percent (489) were introduced to the island. This compares to the total of 1136 reported by Bicknell, 33 percent of which were non-native. Due to taxonomic revisions and re-annotations of specimens, we currently accept 982 of Bicknell's records in our flora. The number of rare species is high, with 23 endangered, 13 threatened, 15 special concern, 46 watch list, and 7 historical, according to the Massachusetts Natural Heritage and Endangered Species Program (1992). The non-vascular flora comprises 79 mosses, 19 liverworts, 1 hornwort, and 99 lichens.

Nantucket has received some of the greatest scrutiny by botanists of any area of similar size (ca. 14,000 ha) in the state. As an example of one of the most completely inventoried regional floras, therefore, it is valuable to examine what deficiencies remain in our knowledge of Nantucket species' occurrence and distribution. From such an analysis, inferences may be drawn regarding the thoroughness of our understanding of the many less intensively studied areas in New England.

Currency of records. Three hundred and twenty-six species, over one-quarter of the flora, have not been recorded in over 60 years. This partially reflects the predilections of many recent botanists, ourselves included, to scour natural habitats for unusual records, and to ignore the back yards, waste dumps, and weed lots of the island. Yet nearly half of this total (153) includes native species, many of which are not weedy. Their absence from

recent lists may not be due to inadequate searching in appropriate habitats.

Number of sites. Many species have been found only rarely on Nantucket. Bicknell noted that almost one-third of the flora (352 species: 182 native, 170 introduced) was recorded from only 1–3 sites. A comparable statistic is not available from our database, and will be the focus of future work. However, our impression is that this number has not declined greatly. About two-thirds of the 326 species for which we have no recent record (>60 years) fall into this group, and many other currently rare species are known only from the same sites where earlier botanists reported them. Lone occurrences of non-native taxa may reflect chance introductions of plants that failed to become permanently established and may no longer be present. The abundance of native species with few records suggests that many may have extremely limited distributions on Nantucket, and may be particularly susceptible to extirpation. Examples include *Gaultheria hispidula*, *Schwalbea americana*, *Botrychium simplex*, and *Cornus amomum*.

Completeness of inventory. It is impossible to determine whether every species occurring on an island the size of Nantucket (ca. 30,000 acres) has been found. Furthermore, the total is always changing as new species are introduced and become naturalized, and others disappear from the island. One approach to assessing the thoroughness of our inventory is to examine the number of new species observations in recent decades. Based on his work from 1958 to 1966 on Nantucket, MacKeever (1968) reported about 50 taxa new to the island, 9 of which were native. Since beginning our work on the island in 1980, about 60 names have been added to the Nantucket vascular plant flora that previously were not recorded; half of these were native. While some of these native species represented taxonomic changes that had not been recognized when earlier compilations of the Nantucket flora were prepared, others were undoubtedly species that simply had been overlooked by previous botanists on the island. Examples include *Scleria pauciflora* var. *caroliniana*, *Amphicarpum purshii*, *Aster acuminatus*, *Polystichum acrostichoides*, and *Amelanchier arborea*.

Our results suggest that even within a relatively small and heavily botanized area such as Nantucket, many questions remain unanswered regarding the nature of the local flora. Several points are worth considering as they may apply elsewhere.

1) Despite over a century and a half of extensive study, additional species continue to be found. These include species new to the island that are common elsewhere, as well as species that are rare regionally.
2) A large number of species are known only from a few sites. Efforts should be made to identify which of these are truly limited in distribution and not merely undercollected. Measures then can be taken to protect sites of locally rare taxa to prevent their extirpation.
3) Our knowledge of much of the current flora may be woefully dated. The preparation and maintenance of large, private herbaria by serious amateurs as well as professionals was relatively widespread at the turn of the century. This practice virtually has disappeared. As a result, much of our information on the presence and distributions of many species is out of date by many decades.
4) Recent work often is conducted by professionals employed by conservation organizations and agencies who focus primarily on rare native species. The tendency to overlook other components of the flora, particularly non-native taxa, leaves conspicuous gaps in our knowledge of local and regional plant geography.

ACKNOWLEDGMENTS AND ADDITIONAL INFORMATION. The production and publication of the Nantucket flora represent a cooperative effort by the Massachusetts Audubon Society, Massachusetts Natural Heritage and Endangered Species Program, Nantucket Maria Mitchell Association, and The Nature Conservancy. Kendra Buresch and Carol Moffitt assisted with much of the document research, data input, and editorial portions of this project. In addition to the support of our own organizations and the cosponsors who helped bring this work together, we are especially grateful for the generosity of the Cox Foundation, Inc. for funding this project. Copies of the flora are available to libraries and serious researchers free of charge while supplies last. The computer database also is available on two 3.5 inch diskettes.

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RHODORA, Vol. 98, No. 893, pp. 99–102, 1996

NEW ENGLAND NOTE

SCLERIA RETICULARIS (CYPERACEAE) NEW TO NEW HAMPSHIRE

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Scleria reticularis Michx., reticulated nut-rush, is a plant of wet, sandy soil and southern pine barrens ranging from tropical America and southern U.S., north mainly along the coast to New England, with disjunct extensions into the midwest and south central states of Arkansas, Oklahoma, Missouri, Illinois, Indiana, Michigan, and Wisconsin (Reznicek 1994). Throughout much of its range *S. reticularis* is found on damp, sandy shores of coastal plain ponds that have broadly fluctuating water levels. Sorrie (1994) reports on the distribution of these ponds in New England, noting their primary concentration on the glacio-fluvial deposits of southeastern Massachusetts, adjacent Rhode Island and discontinuous localities in Connecticut, inland Massachusetts and the Ossipee Lake region of New Hampshire and Maine. Records compiled by the Massachusetts Endangered Species and Natural Heritage Program indicate that *S. reticularis* is extant and locally abundant on pond borders in 7 towns in Plymouth, Barnstable and Nantucket Counties, with 61 stations recorded as of 1989. At this time, documentation of new occurrences was discontinued. An extant station in the Connecticut River valley in the south-central Massachusetts town of Ludlow, Hampden County, is disjunct from the main distribution. A single historic station at Winter Pond, Winchester, Middlesex County, has not been observed since 1933 and possibly is extirpated. There are 3 extant populations in Washington County in southern Rhode Island and an historic collection from Providence County to the north (Rhode Island Natural Heritage Program). Thus the New Hampshire population discussed here is nearly 75 miles (123 km) disjunct from the nearest extant population in Massachusetts.

A small population of *Scleria reticularis* (*Sperduto 2344* NHA, NEBC, MICH; *Sperduto 3162* NHA) was discovered on the sandy, shallow-peat upper shore of Rocky Hill Pond in Litchfield, Hillsborough County, New Hampshire on September 16, 1992 by the author, Lesley Sneddon and Mark Anderson.

The majority of several hundred plants observed was found along a short section of the pond margin. Numerous other species characteristic of coastal plain pondshores in New England were associated with the *Scleria* including *Rhexia virginica, Eleocharis tenuis, Agrostis hyemalis, Glyceria borealis, G. acutiflora, Juncus pelocarpus, J. canadensis, Drosera intermedia, Gratiola aurea, Hypericum boreale, H. gentianoides, Dulichium arundinaceum, Panicum spretum, P. tuckermanii, Cyperus dentatus, Viola lanceolata, Rhyncospora capitellata, Bulbostylis capillaris,* and *Fimbristylis autumnalis.* Other species elsewhere in the basin include *Euthamia tenuifolia, Xyris difformis* var. *difformis, Vaccinium macrocarpon, Lindernia anagallidea, Scirpus smithii, Eleocharis smallii, E. olivacea, E. obtusa, Potamogeton bicupulatus, P. oakesianus, Nymphoides cordata, Utricularia radiata* and *Myriophyllum humile.* A total of 80 species was recorded in the wetland habitats of the pond basin.

Rocky Hill Pond is found in a 2.7 acre basin blanketed by one to several meters of sand deposits overlying deeper, fine-textured lake-bed sediments of the postglacial Lake Merrimack (Goldthwait et al. 1969; J. E. Cotton, USGS, pers. comm.). This portion of the southern Merrimack River valley contains an extensive groundwater aquifer associated with the reworked glaciofluvial and glacio-lacustrine deposits of the former Lake Merrimack. The pond basin has a moderately shallow profile with a maximum depth of 1.2 meters below the upland margin. Intermittent observations over several years from 1991–1994 revealed widely fluctuating seasonal and annual water levels. The pond level rises every spring, occupying essentially the entire 2.7 acre basin, and rises and falls with seasonal variation in precipitation and groundwater levels. At its lowest observed point in September 1993, the water depth was only 10–20 cm and occupied less than a quarter acre. In general, the upper borders of the basin (e.g., where *Scleria* was observed) had several centimeters of peat over a sandy muck layer to a depth of 0.2–0.3 m, over fine to coarse sands to at least 1.2 m (extent of auger). Some middle areas of the basin had a more rapid transition to sand, while the lowest part of the basin had a full meter of surface muck over sand. Organic matter content determined by ignition of soil samples in a muffle furnace indicated a 63% organic matter content in the vicinity of greatest *Scleria* abundance. Several meters away in wet-

ter habitat where *Scleria* was sparse, organic matter content was 20%.

A series of small wetland basins similar to Rocky Hill Pond can be found elsewhere in Litchfield and adjacent towns of the lower Merrimack River valley sandplain, ranging from single basins less than 1 acre in size to complexes of basins totaling as much as 11 acres. Although detailed surveys have not revealed any other populations of *Scleria reticularis,* many of these wetlands do harbor various combinations of the pondshore associates mentioned above (Sperduto 1994). Rocky Hill Pond is unique among these basins with its broad gradient of wetland habitats ranging from semipermanently to temporarily flooded zones. Each zone occupies significant area due to the moderate slope of the basin profile. This diversity of conditions seems to contribute to the higher species richness as compared to other, often larger, basin complexes of the sandplain system. The discovery of *Scleria reticularis* and associated plants in New Hampshire's lower Merrimack River valley expands the known range of coastal plain pondshore flora from distributions described by Sorrie (1994) for New England.

During the 1980s several houses were constructed immediately around the pond. A road has been built approximately 10 meters from the pond's west shore with a culvert directed into the basin. Direct water pumping from the pond and other local residential and commercial aquifer pumping have the potential to modify natural fluctuations. As with other coastal plain pondshores in the region, development and its associated secondary impacts may diminish the potential long-term viability of the *Scleria reticularis* and other constituents of the coastal plain pondshore flora unless there are concerted local conservation efforts, including community cooperation (Keddy and Reznicek 1982; McCarthy 1987; Keddy and Wisheu 1989).

ACKNOWLEDGMENTS. I thank T. J. Rawinski for his earlier field work in the lower Merrimack River valley which led to and inspired my interest in NH's coastal plain affinities. I also thank A. A. Reznicek for identification confirmation of *Scleria* collections, and T. D. Lee for critical review of this note. The Nature Conservancy and the Environmental Protection Agency are gratefully acknowledged for their support for coastal plain pondshore research in NH.

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RHODORA, Vol. 98, No. 893, pp. 103–104, 1996

BOOK REVIEW

Sorrie, Bruce A. and Peter W. Dunwiddie. 1996. *The Vascular and Non-Vascular Flora of Nantucket, Tuckernuck and Muskeget Islands*. 145 pp. Published jointly by the Massachusetts Audubon Society, the Massachusetts Natural Heritage and Endangered Species Program, Nantucket Maria Mitchell Association, and The Nature Conservancy, Nantucket, MA. ISBN 0-932691-18-8.

The authors have compiled an extraordinary list of the recorded flora of Nantucket and its adjacent islands, to provide information for further study on floristic changes. In addition to the basic flora and descriptions of community types, the book provides an excellent account of the history of botany on Nantucket (surprisingly, Fernald never visited the island). The authors of this book, through extensive research in 9 regional herbaria and 16 years of field work, have produced a list of 2165 taxa (including interspecific hybrids) documented from Nantucket and nearby islands, with 79 species of mosses, 19 liverworts, 1 hornwort, and 99 lichens. Muskeget and Tuckernuck, although small and with few plant community types, still support considerable plant species diversity (160 and 353 species, respectively).

The Nantucket flora contains 51 state-listed endangered, threatened, or special concern species. A significant proportion (39%) of the flora consists of introduced species. This may in fact be an underestimate, as there are several introduced species that are not so designated in the text (*Mentha spicata, M. piperata, Origanum*). The list also includes a number of species known only from cultivation, such as silver maple and dill. The authors note that 153 of the native species have not been collected during the past 60 years, with the question of whether this represents extirpation or lack of collection left for future research.

For each listed taxon, the book lists available synonyms, common names, habitat types, state list category, status as introduced or introduced from the mainland, whether the plant is invasive, and notes on frequency. Habitat types are not provided for many species of mosses, and there are no moss records from Muskeget or Tuckernuck.

The Flora is largely free of typographic and printing errors. Separate indices are provided for vernacular and scientific names. Unfortunately, the vegetation maps provided use a different clas-

sification system than was developed by the authors. A computerized database, on Microsoft Access 2.0, is available on diskette from The Nature Conservancy. This allows searches by family, genus, species, variety/subspecies, author, common name, growth form, state rank, synonymy, habitat, location, and collected specimens.

The nomenclature used is eclectic. The authors largely follow Gleason and Cronquist (1991), occasionally substituting names from Kartesz (1994) or Flora North America, Vol. 2. However, the authors have chosen to list taxa (particularly infraspecific taxa) that they consider valid but that are not recognized by Cronquist, Kartesz, or the FNA authors. This may cause problems for many botanists attempting to correlate field observations to the Flora.

—Lisa A. Standley, VHB, Inc., 101 Walnut Street, Watertown, MA 02272.

RHODORA, Vol. 98, No. 893, pp. 105–106, 1996

BOOK REVIEW

Buckley, Ann and Theodore O. Hendrickson. 1996. *Native Trees, Shrubs and Woody Vines of Cape Cod and the Islands.* vi + 70 pp. The Natural History of Southeastern New England, University of Massachusetts Dartmouth Print Shop. Available from UMass Dartmouth Bookstore, Dartmouth, MA 02714. $12.95.

Any book which attempts to explain any portion of the natural world to the general public is desirable and important. This book(let), which is part of a series devoted to the natural history of southeastern New England, is particularly important because the large numbers of summer visitors who visit the area now have a source of information about, at least, the common native and naturalized woody plants.

The authors apparently set a very limited goal for themselves, viz., to provide keys to, small line drawings of the twigs and leaves of, and very brief descriptive comments about, 125 common woody species. What they have done is successful. It is unfortunate that they did not try to do more. If they wish public support (e.g., money), scientists have an obligation to try to show the general public what it is that they find exciting about their field of study, what interesting information they uncover. The public is interested in information.

It would have been nice if the readers could learn:

1. How many kinds of higher plants are native to Cape Cod and the Islands? How many of them are trees, shrubs and vines? (Svenson and Pyle's *Flora of Cape Cod,* 1979 is apparently long out of print and not readily available to the public.)
2. How were the particular species selected? One wonders, for example, at the absence of *Ailanthus.*
3. It would be worth noting, in these days when species extinction is a topic of conversation, how quickly some exotics have become naturalized (and what did they replace?).

Ailanthus altissima, introduced to this country in 1784, was beginning to naturalize by 1870, and was noted as a roadside escape around New Bedford and Buzzards Bay in 1911.

Berberis thunbergii, introduced into cultivation in North America about 1864, was still noted as a garden plant around New

Bedford and Buzzards Bay in 1911; it is not mentioned in the 7th edition of Gray's Manual (1907).

Berberis vulgaris (introduced in colonial times), which only received passing mention in the booklet, was widely distributed in 1907. Has it become more uncommon in the intervening 90 years?

Lonicera japonica was introduced in 1806, naturalized from Connecticut to Florida by 1907, but was still only a garden plant around New Bedford and Buzzards Bay in 1911.

Robinia pseudoacacia was esteemed for ship building (in particular for the production of trunnels [tree nails]) and for rot-resistant posts. A southern species, it was widely planted in New England by farmers. It seems, in many areas, not to spread by seed, so the clumps we find are memorials to some former farmer's diligence.

Rosa rugosa was introduced into cultivation in this country about 1845. It was noted, with *Rosa multiflora* (introduced sometime before 1868), as a garden plant around New Bedford and Buzzards Bay in 1911. It was first noted as an escape in 1912.

And this doesn't mention the deforestation and reforestation of Cape Cod. There is so much that the visitor would find interesting.

—Gordon P. DeWolf, RD 1, Box 9, 125 Long Hill Road, West Brookfield, MA 01585.

RHODORA, Vol. 98, No. 893, pp. 107–109, 1996

NEBC MEETING NEWS

February 1996. Judith Warnement, Head Librarian of the Botany Libraries at Harvard, spoke on "Harvard Botanists and Their Libraries." These five botanical libraries are closely tied to Harvard's history and to the personalities and relationships among its botanists, since most libraries were started as the personal collections of Harvard botanists.

The first botanical institution, the Botanical Garden, was started by Peck in 1807, and continued by Nuttall. Asa Gray succeeded Nuttall in 1842, having already demonstrated a passion for books. Before coming to Harvard, Gray had traveled to Europe and purchased 3700 books in Europe to start a botanical library at the University of Michigan. The Bussey Institute was started in Jamaica Plain in 1871, and focused on farming, agriculture, and horticulture. The Arnold estate, deeded to Harvard for the promotion of agriculture and horticulture, was used to establish an arboretum at the Bussey Institute.

Gray assembled a group of botanists at Harvard, each of whom was the center of a different institution and library. These included Sereno Watson at the Herbarium, Farlow in cryptogamic botany, Goodall in economic botany and physiology, and Sargent at the Botanic Garden. Goodall developed the Botanical Museum, with its collections in economic botany, paleobotany, and the Glass Flowers. Sargent, who apparently did not get along with the others, moved to Jamaica Plain to develop the Arboretum. During his 55-year tenure, he built the Arnold Arboretum's library, and met its budget shortfalls from his own fortune. Farlow's large personal library was given to Harvard on the condition that a fireproof building would be constructed. In 1864, Gray gave his library of 2200 volumes to the Botanical Garden.

The modern Gray Herbarium library was shaped by its librarian, Mary Day, who worked under B. L. Robinson for 30 years. She created the library's unique classification system, replacing an even more eccentric system of filing by size. She also developed the Gray Index, and personally prepared 170,000 cards. Oakes Ames saw the libraries and botanical institutions through WWI and the Depression, created an economic botany library, and donated his orchid library and collection to Harvard.

By the 1950s, a century of "rampant individualism" had created a dispersed collection of botanical institutions, including 11 organizations funded by 9 separate endowments. Irving W. Bailey

recommended their consolidation into a single institution and building. The Friends of the Arnold resisted consolidation, and initiated a lawsuit that was settled after 13 years of litigation. Despite the ongoing legal action, the libraries of the Gray Herbarium, Arnold Arboretum, and Economic Botany, the Ames Orchid Library, and the Farlow Library were merged in the mid-1950s. These libraries are now managed by a single staff, but are maintained in accordance with various bequests and a court order. Together, there are 230,000 volumes in Cambridge, and an additional 35,000 volumes at Jamaica Plain. The five different classification systems are being converted to the Library of Congress system, and are being catalogued onto the electronic database at a rate of 10,000 volumes a week.

Judy ended her talk with a quote from George Bentham, correcting our plant-centered viewpoint and reminding us that "A botanical library is useful without a herbarium, but not a herbarium without a library."

March 1996. Outgoing President Barre Hellquist spoke on "Non-native and Weedy Aquatic Plants of Northeastern United States." Over the years, he has experimented with growing native and introduced species, and explored an interest in the aggressive qualities of aquatic species.

The USDA has listed several noxious weeds which it is illegal to possess, including *Azolla pinnata, Eichhornia azurea, Lagarosiphon major,* and *Salvinia molesta*. Despite these prohibitions, several of these are already present in parts of the U.S., and can be obtained from suppliers or institutions. Botanical gardens appear to have been the source of many problem introductions. This group includes *Hydrocharis, Marsilea quadrifolia, Myriophyllum spicatum, Najas minor* and *Potamogeton crispus*. *Trapa natans,* the only plant legally outlawed in Massachusetts, was first recorded at the Cambridge Botanical Garden in 1877.

Emergent aquatics such as *Butomus, Iris pseudacorus,* and *Lythrum salicaria* are more attractive nuisances, and may not pose as much of a threat to aquatic systems. *Phragmites* is the most aggressive species in this group, and is almost impossible to eradicate. The debate over whether this species is introduced or native has not been resolved—the first New England record is from 1879 near Hartford, but specimens were collected in Texas in 1828.

South American aquatics contain some of North America's worst weeds, but are not found in New England—yet. Several of

these (*Alternanthera, Eichhornia, Pistia*) cannot survive winter conditions. Others, including *Egeria densa* and *Myriophyllum aquaticum,* occur in New England but are sparse and localized.

Barre identified several non-native species adapted to cold water that may be of concern as possible weeds. *Aponogeton distachyus, Nelumbo nucifera, Typha laxmanii* and *Typha minima* have aggressive growth forms and are tolerant of New England climates. Several North American natives (outside of New England) also have weedy tendencies and could be a problem here. *Cabomba caroliniana,* first recorded from Rhode Island in 1892, has become a widespread problem in acidic ponds of southern New England and in the Albany area. *Myriophyllum heterophyllum* is a robust native first reported in 1932 in Connecticut. Recently outcompeted there by Eurasian Milfoil, it is now spreading in New Hampshire.

Threats from the aggressive aquatics lurk in every pond. Even the attractive water lilies can become a nuisance unless grazed by moose, and *Typha latifolia* requires control by muskrats to keep it from dominating shallow aquatic sites. *Potamogeton amplifolius, Coleogeton pectinatus, Lemna* spp., *Wolfia* spp., and *Utricularia* (both *inflata* and *purpurea*) may all form dense stands in New England waters, reducing the value of ponds or lakes for swimming and boating. Barre closed with the question of how conservation groups should regard those native aquatics that have recently expanded their distributions into New England states: as rare—or as weeds?

—Lisa A. Standley, Recording Secretary.

RHODORA, Vol. 98, No. 893, pp. 110, 1996

NEW ENGLAND BOTANICAL CLUB GRADUATE STUDENT RESEARCH AWARD

The New England Botanical Club will offer an award of $1,000 in support of botanical research to be conducted by a graduate student in 1997. This award is made annually to stimulate and encourage botanical research on the New England flora, and to support visits to the New England region by those who would not otherwise be able to do so.

The award will be given to the graduate student submitting the best research proposal dealing with systematic botany, biosystematics, plant ecology, or plant conservation biology, although research in other areas will be considered.

Applicants must submit a proposal of no more than three double-spaced pages, a budget (the budget will not affect the amount of the award), a curriculum vitae, and two letters in support of the proposed research, one from the student's thesis advisor. Three copies of the proposal must be submitted.

Proposals and supporting letters must be received no later than March 1, 1997. The recipient will be notified by April 30, 1997. Send proposals to: Awards Committee, The New England Botanical Club, 22 Divinity Avenue, Cambridge, MA 02138.

The 1996 Graduate Student Research Award was presented to Bruce Henning Lindwall, University of Massachusetts (Amherst), for his study titled "The genetic consequences of long-term habitat fragmentation."

RHODORA, Vol. 98, No. 893, pp. 111, 1996

THE 1996 JESSE M. GREENMAN AWARD

The 1996 Jesse M. Greenman Award has been won by Paul Kores for his publication "A systematic study of the genus *Acianthus* (Orchidaceae: Diurideae)," published in Allertonia 7: 87–220 (1995). This study is based on a Ph.D. dissertation from Tulane University under the direction of Dr. Steven P. Darwin.

The Greenman Award, a certificate and a cash prize of $1,000, is presented each year by the Missouri Botanical Garden. It recognizes the paper judged best in vascular plant or bryophyte systematics based on a doctoral dissertation published during the previous year. Papers published during 1996 are now being accepted for the 29th annual award, which will be presented in the summer of 1997. Reprints of such papers should be sent to Dr. P. Mick Richardson, Greenman Award Committee, Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A. In order to be considered for the 1997 award, reprints must be received by 1 June 1997.

RHODORA, Vol. 98, No. 893, pp. 112–113, 1996

STUCKEY PRESENTS ENDOWMENT GIFT TO OSU STONE LABORATORY

Ronald L. Stuckey, Professor Emeritus of Botany at The Ohio State University, announced his donation of a $15,000 contribution to the Franz Theodore Stone Laboratory, on the occasion of the Laboratory's 100th Anniversary Celebration on Gibraltar Island, Put-in-Bay, Ohio, 24 August 1996.

Dr. Stuckey's contribution was made in November 1995 and approved by the Board of Trustees of The Ohio State University, 2 February 1996. The donation establishes an endowment whose income will provide annual financial support to employ a faculty-level individual to teach a course in vascular aquatic plants. The aquatic plants course was Professor Stuckey's chief instructional responsibility at the Laboratory when he taught there from 1966 to 1991. He offered the course 18 of the 25 summers he worked at the Laboratory. Stuckey chose to announce the gift in the form of a poem he wrote, titled, "Of Life, Friends, Death, and Giving."

To show their appreciation for the gift, officials presented Professor Stuckey with two awards. The Director of the Laboratory, Jeffrey M. Reutter, honored Stuckey with a Partnership Award, a plaque with the inscription, "*In Recognition of Your Numerous Contributions to Stone Laboratory and Your Efforts to Permanently Endow a Faculty Position For Your Course—Higher Aquatic Plants, 24 August 1996.*" The second award was given by Michael Ahern, 1995–1996, President of the Friends organization. This group, who simultaneously were holding their annual meeting, consists of former students, faculty, staff, and others who volunteer their time, make financial gifts, or offer other kinds of donations to the Laboratory. Dr. Stuckey's second plaque was inscribed, "*For your outstanding support and dedication to Stone Laboratory.*" The award also carried the title "*Centennial, 1896–1996, 100 Years of Education and Research at Franz Theodore Stone Laboratory.*" Stuckey's endowment, the eighth one established by the Friends organization for the Laboratory, is the first one for a specific course of instruction, and is believed to be the first of its kind in the country for a course in aquatic plants.

Dr. Stuckey's major research at the Laboratory focuses on the changes in abundance and distribution of aquatic and wetland plants in western Lake Erie. In 1971, Stuckey published a paper

in the *Ohio Journal of Science* documenting that 50% of the aquatic plant species in Put-in-Bay Harbor had disappeared since 1900. With the invasion of the zebra mussels, the water is much clearer and cleaner now, and several of the species have returned following this environmental change. This recent study, published in the same journal (1995) is co-authored by Stuckey and his former student, David L. Moore, who now teaches the aquatic plants course at the Laboratory. Their paper represents the first known study of its kind documenting the return of aquatic plants to a site where they once had disappeared. Their work has been reported recently in the *Cleveland Plain Dealer, Chicago Tribune, Detroit News,* and in the magazines *Business Week* and *Discover.*

Stuckey has participated in the Laboratory during five decades, first as a student while he attended Heidelberg College (1959), as a faculty member (1966–1991), and as the Associate Director for the Educational Program (1977–1985). He is currently writing the 100-year history of the Laboratory.

INFORMATION FOR CONTRIBUTORS TO RHODORA

Submission of a manuscript implies it is not being considered for publication simultaneously elsewhere, either in whole or in part.

GENERAL: Manuscripts should be submitted in triplicate. The text must be double-spaced throughout, including tables, figure legends, and literature citations. Use a non-proportional font throughout and do not justify the right margin. Do not indicate the style of type through the use of capitals, underscoring, or bold, except for names of genera and species which should be in italics or underscored throughout. Do not underline punctuation. All pages should be numbered in the upper right-hand corner. For guidance in matters not addressed here, consult the editorial office by phone at (603) 862-3205, FAX (603) 862-4756, or e-mail: janets@christa.unh.edu. Brevity is urged for all submissions.

TITLE, AUTHOR(S), AND ADDRESS(ES): Center title, in capital letters. Omit authors of scientific names. Below title, include author(s) name(s), affiliation(s), and address(es). If "present address" is different, it should follow immediately below, not as a footnote.

ABSTRACT: An abstract and a list of key words should be included with each paper, except for shorter papers submitted as Notes. An abstract must be one paragraph, and should not include literature citations or taxonomic authorities. Please be concise, while including information about the paper's intent, materials and methods, results, and significance of findings.

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FLORAS AND TAXONOMIC TREATMENTS: Specimen citation should be selected critically, especially for common species of broad distribution. Keys and synonymy for systematic revisions should be prepared in the style of "A Monograph of the Genus *Malvastrum*," S. R. Hill, RHODORA 84: 159–264, 1982. Designation of a new taxon should carry a Latin diagnosis (rather than a full Latin description), which sets forth succinctly how the new taxon differs from its congeners.

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TABLES: Tables must be double-spaced. Tables may be continued on an extra page, if necessary. As much as possible, the title should be self-explanatory. Do not use footnotes; instead, add notes after the end of the table title. Broadside tables should be avoided, if possible. Each table should be cited in the text in numerical order.

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THE NEW ENGLAND BOTANICAL CLUB
22 Divinity Avenue
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The New England Botanical Club is a nonprofit organization that promotes the study of plants of North America, especially the flora of New England and adjacent areas. The Club holds regular meetings, and has a large herbarium of New England plants and a library. It publishes a quarterly journal, RHODORA, which is now in its 99th year and contains about 400 pages per volume. Visit our web site at http://www.herbaria.harvard.edu/nebc/

Membership is open to all persons interested in systematics and field botany. Annual dues are $35.00, including a subscription to RHODORA. Members living within about 200 miles of Boston receive notices of Club meetings.

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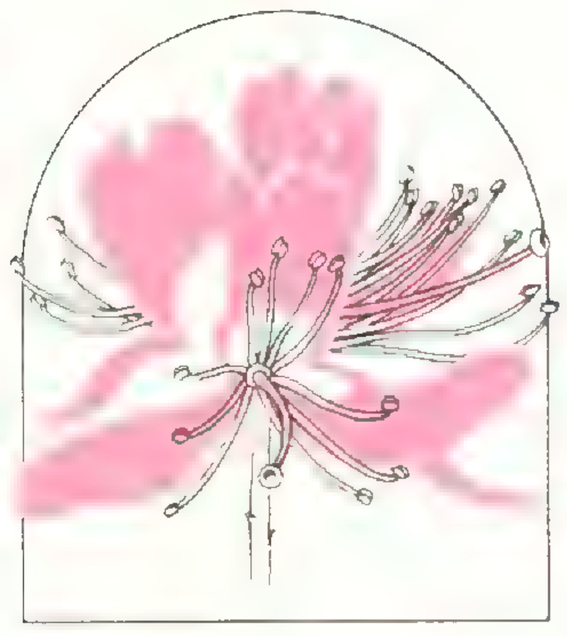
Volume 97, No. 892 including pages 291–394 was issued January 3, 1997



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New England Botanical Club

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Vol. 98 **Spring, 1996** **No. 894**

Issued: May 28, 1997

The New England Botanical Club, Inc.

22 Divinity Avenue, Cambridge, Massachusetts 02138

RHODORA

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RHODORA (ISSN 0035-4902). Published four times a year (January, April, July, and October) by The New England Botanical Club, 810 East 10th St., Lawrence, KS 66044 and printed by Allen Press, Inc., 1041 New Hampshire St., Lawrence, KS 66044-0368. Periodicals postage paid at Lawrence, KS. POSTMASTER: Send address changes to RHODORA, P.O. Box 1897, Lawrence, KS 66044-8897.

RHODORA is a journal of botany devoted primarily to the flora of North America. Monographs or scientific papers concerned with systematics, floristics, ecology, paleobotany, or conservation biology of the flora of North America or floristically related areas will be considered.

SUBSCRIPTIONS: $75 per calendar year, net, postpaid, in funds payable at par in United States currency. Remittances payable to RHODORA. Send to RHODORA, P.O. Box 1897, Lawrence, KS 66044-8897.

MEMBERSHIPS: Regular $35; Family $45; Student $25. Application form printed herein.

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BACK ISSUES: Information on availability of back issues should be addressed to Dr. Cathy A. Paris, Department of Botany, University of Vermont, Burlington, VT 05405-0086. E-mail: cparis@moose.uvm.edu.

ADDRESS CHANGES: In order to receive the next number of RHODORA, changes must be received by the business office prior to the first day of January, April, July, or October.

INFORMATION FOR CONTRIBUTORS: See contents. Submit manuscripts to the Editor-in-Chief.

♾ This paper meets the requirements of ANSI/NISO Z39.48-1992 (Permanence of Paper).

RHODORA, Vol. 98, No. 894, pp. 117–145, 1996

A CLASSIFICATION OF COASTAL HEATHLANDS AND SANDPLAIN GRASSLANDS IN MASSACHUSETTS

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ABSTRACT. A set of 372 vegetation relevés was collected from coastal sandplain communities on Nantucket, Cape Cod, and Martha's Vineyard. Sites on Nantucket had the highest average number of rare species and the lowest number of non-native species. We used TWINSPAN to identify major vegetation types from these data. The first division separated the samples into heathlands and grasslands. Heathlands subsequently were classified into two major types: 1) Tall Shrub, including Huckleberry-Scrub Oak (*Gaylussacia baccata-Quercus ilicifolia*) and Mixed Maritime Shrublands (*G. baccata, Myrica pensylvanica*, and others), and 2) Low Shrub, including Broom Crowberry (*Corema conradii*) and Bearberry (*Arctostaphylos uva-ursi*) Heathlands. The two major grassland types were designated Hairgrass (*Deschampsia flexuosa*) and Little Bluestem (*Schizachyrium scoparium*), after the dominant taxa. Hairgrass Grasslands included a Beach subtype often dominated by coastal species (*Ammophila breviligulata, Hudsonia tomentosa*), and a Heathy Grassland that includes many ericads and graminoids. Little Bluestem Grasslands were divided into several subtypes, including Weedy Grasslands with many introduced species, Pennsylvania Sedge Grasslands dominated by *Carex pensylvanica*, and High Diversity Native Sandplain Grasslands, which included many rare species, few exotics, and high species diversity. We discuss successional relationships among sandplain vegetation types.

Key Words: sandplain grassland, coastal heathland, community classification, two-way indicator species analysis, *Schizachyrium scoparium, Arctostaphylos uva-ursi, Gaylussacia baccata, Deschampsia flexuosa, Quercus ilicifolia*

The easternmost grasslands in North America occur in the coastal sandplains of the northeastern United States from Long Island (New York) to Cape Cod (Massachusetts). Similar to midwestern prairies, they usually are dominated by *Schizachyrium scoparium*, but also include a distinctive association of primarily coastal taxa. Many regionally and globally rare plants occur in

the sandplain grasslands, including such taxa as bushy rockrose (*Helianthemum dumosum*), yellow sandplain flax (*Linum intercursum*), sandplain blue-eyed grass (*Sisyrinchium fuscatum*), sandplain gerardia (*Agalinis acuta*), and eastern silvery aster (*Aster concolor*). The grasslands also provide critical habitat for various uncommon or declining fauna, including Short-eared Owls (*Asio flammeus*), Northern Harriers (*Circus cyaneus*), Upland Sandpipers (*Bartramia longicauda*), Grasshopper Sparrows (*Ammodramus savannarum*), and Regal Fritillary Butterflies (*Speyeria idalia*). This community is referred to variously as maritime grassland (Reschke 1990), New England sandplain grassland (Maine Natural Heritage Program 1991), or terrestrial *Schizachyrium scoparium* medium-tall graminoid vegetation (Sneddon and Metzler 1992). It is considered endangered throughout its range, where considerable efforts are being made to preserve and manage the remaining examples (Massachusetts Natural Heritage Program 1982; Rawinski 1984; Godfrey and Alpert 1985).

The coastal sandplain grasslands frequently include a large component of woody species, many of which are ericads. Where heath taxa are dominant, the community has been termed maritime or coastal heathlands (Reschke 1990), and can be found from New Jersey to the Canadian Maritimes. In Massachusetts, heathland and grassland plants are often intermixed, and the communities sometimes are not readily distinguished. They often share many species with other coastal communities, such as sand dunes and scrub oak/pitch pine (*Quercus ilicifolia/Pinus rigida*) barrens.

The past extent of coastal grasslands and heathlands is uncertain. A few historical accounts describe the presence of maritime grasslands along the coast, and suggest that they may predate European settlement (Harper 1912). Furthermore, it is unlikely that the many rare native species found in the coastal sandplain communities arrived in the last 300 years, the period since settlement in this area by Europeans. However, fossil pollen studies on Cape Cod and Nantucket indicate that grasslands and heathlands became extensive only following settlement (Winkler 1985; Tzedakis 1987; Dunwiddie 1989, 1990). The species found in these communities today most likely existed prior to European settlement in openings close to the coast where salt spray suppressed the growth of woody plants, and in openings created by windstorms, fires, and aboriginal agricultural activities.

Forest clearance to create fields for crops and pastures quickly

followed settlement in the 1600s (Dunwiddie 1990). Cultivation of crops often was brief, as soils were exhausted quickly (Macy 1835), but grazing, fire, salt spray, and other disturbances probably helped to maintain grasslands and heathlands in many areas for several hundred years. Introduced pasture grasses did poorly in the acidic, droughty soils, and native grassland species thrived in the pastures and abandoned fields. With the widespread abandonment of sheep grazing in the late 1800s on Cape Cod, Nantucket, and Martha's Vineyard many grasslands and heathlands have been overtaken by taller shrub and forest vegetation (Dunwiddie 1992, 1994; Dunwiddie and Adams 1994).

Today, many conservation organizations are working to preserve rare grasslands and heathlands (Godfrey and Alpert 1985). A top priority has been to develop ecological management strategies for slowing or reversing the succession of shrubs and trees (Dunwiddie and Caljouw 1990). This management has been hampered by an incomplete understanding of the compositional, environmental, successional, and historical relationships among these vegetation types. This study was undertaken to develop a classification of coastal grasslands and heathlands in Massachusetts based on their vegetational composition. Using data sets from sites on Cape Cod, Nantucket, and Martha's Vineyard, we differentiate major types of grasslands and heathlands in this region, identify those types that are most likely to contain rare species, and propose likely successional relationships among them.

METHODS

The grasslands and heathlands on Nantucket, Martha's Vineyard, and Cape Cod (Figure 1) all occur within a few kilometers of the coast on coarse-grained glacial moraine and outwash deposits. Sites were chosen for sampling based on personal knowledge and on information from the files of the Massachusetts Natural Heritage and Endangered Species Program. At each site we noted the area and extent of communities and made general descriptions of topography, land use, location, recent disturbance history (if known), and species composition.

Locations for relevés were selected to characterize the range of vegetation types that occurred at each site. The initial data set for this study consisted of 233 relevés collected on Nantucket in

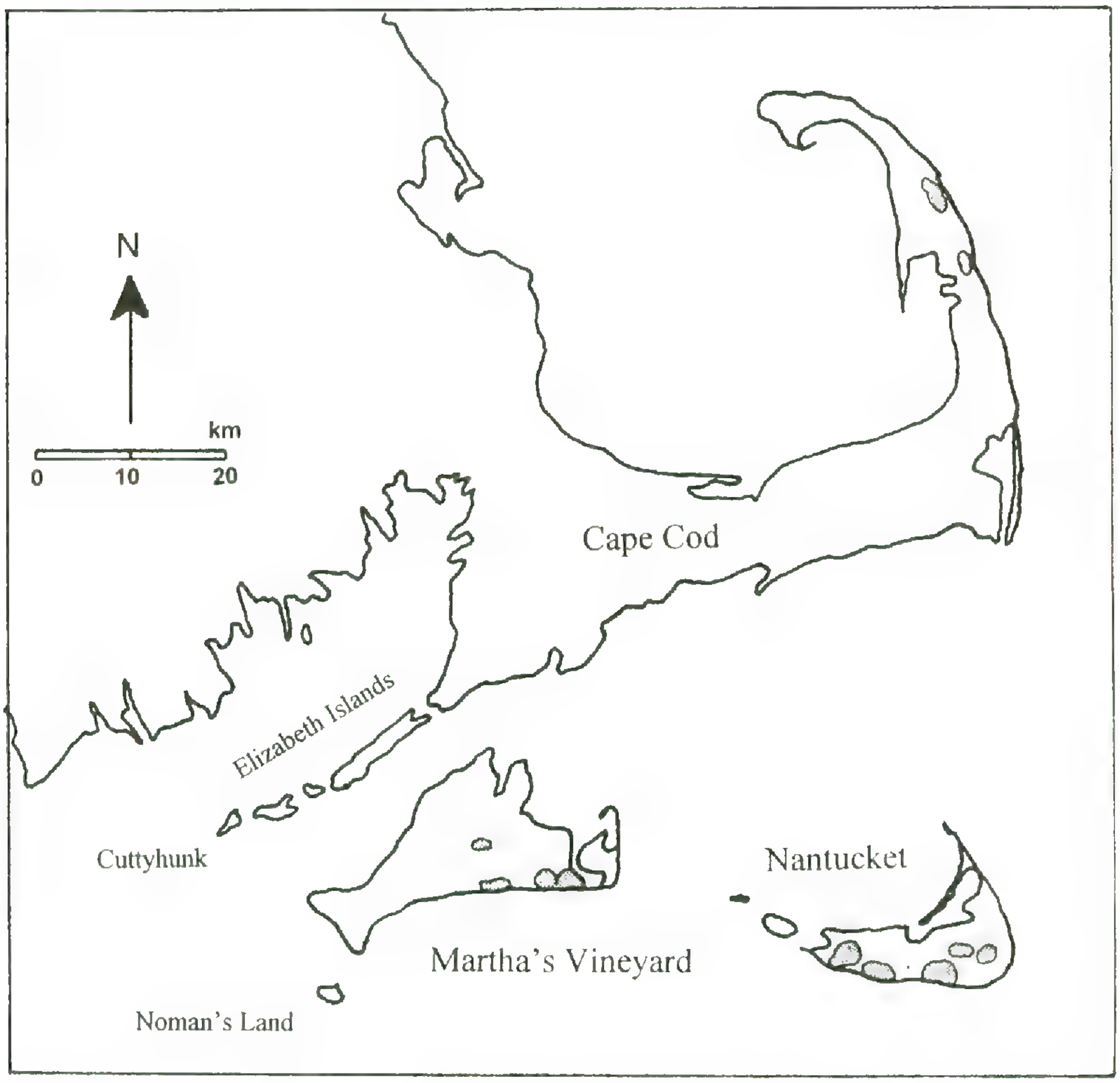

Figure 1. Locations in southeastern Massachusetts mentioned in the text. The larger grasslands and heathlands in which many relevés were located are indicated with shading. Small sites are not depicted.

1982. To maintain consistency among the data, we used the same methodologies to collect 119 additional relevés on Cape Cod and Martha's Vineyard in 1992, and an additional 20 from Nantucket. This methodology consisted of listing all species encountered within a 10 m radius plot and ranking them on a dominance scale of 1 (low) to 4 (high). Dominance values (d.v.) of 1 corresponded to rare species in each plot with <1 percent cover; values of 4 were assigned to dominant species with cover values that generally were much >50 percent. Values of 2 and 3 distinguished intermediate levels of abundance, with a cover of about 15 percent roughly separating these two classes. This methodology adequately distinguished dominant from minor species on sites and

yielded comparable results when applied by different investigators.

A total of 372 relevés, including 253 from Nantucket, 28 from 13 sites on Martha's Vineyard, and 91 from 37 sites on Cape Cod, were ordinated and classified using two-way indicator species analysis (TWINSPAN; Hill 1979) from the Cornell Ecology Program. TWINSPAN distinguishes groupings of sites with similar species associations and is particularly helpful where the high number of species and samples may obscure elements in common between sites (Jongman et al. 1987). Community classifications make more intuitive sense when based on common species rather than on species that only occur infrequently, so we explored various combinations of weightings of the dominance values. Several trials yielded similar results, and we present here results in which weights of 10 and 5 were attached to the more common species (d.v. = 4 and 3), and less common species (d.v. = 2 and 1) were left unweighted.

We included all 274 taxa recorded from the relevés in the first trial TWINSPAN classification, and made several adjustments in subsequent trials. Species for which some taxonomic confusion in the field may have resulted in differential identification by the various data gatherers were combined into several composite "supertaxa," such as species of *Agrostis,* mosses, and a few minor taxa. Lichens were omitted entirely as input to the classification since they were not identified to species. Ten relevés formed anomalous small groupings, and were discarded in the final classification. Nomenclature follows Gleason and Cronquist (1991).

For each of 20 Nantucket relevé sites, four replicate soil samples were taken from the top 15 cm of the soil profile, excluding the litter layer. Soil pH was measured in 0.01 M $CaCl_2$, and texture (percent sand, silt, and clay) was determined using Bouyoucos hydrometer methods. Exchangeable cations (magnesium, calcium, sodium, potassium) were measured by shaking samples in 1N ammonium acetate for 30 minutes, and analyzing the supernatant using a Jobin-Yvon Inductively Coupled Plasma spectrophotometer. Organic carbon:nitrogen ratios were measured using a Perkin-Elmer 2400 CHN.

RESULTS

Most of the groups of relevés produced by the dichotomies in the TWINSPAN classification include recognizable associations

Table 1. Percent frequency of species in grassland and heathland relevés. Vegetation types are derived from TWINSPAN classification (Figure 2): GL = Grassland, LB = Little Bluestem, W = Weedy, PS = Pennsylvania Sedge, HDN = High Diversity Native Sandplain Grassland, Hg = Hairgrass, HG = Heathy Grassland, B = Beach Grassland, HL = Heathland, LS = Low Shrub, BB = Bearberry, BC = Broom Crowberry, TS = Tall Shrub, HSO = Huckleberry/Scrub Oak, MMS = Mixed Maritime Shrubland. In general, species are arranged according to their decreasing frequency in several major

TWINSPAN Group	I	A	A1	A2a	A2b
Vegetation Type	GL	LB	W	PS	HDN
Schizachyrium scoparium	92	96	95	92	99
Carex pensylvanica	84	91	72	100	97
Arctostaphylos uva-ursi	76	62	15	50	91
Danthonia spicata	75	80	54	77	95
Lechea maritima	69	60	15	50	88
Myrica pensylvanica	68	72	77	50	77
Aster linariifolius	68	60	33	54	76
Quercus ilicifolia	63	53	38	73	54
Aster paternus	61	67	26	54	93
Vaccinium angustifolium	61	71	56	81	74
Gaylussacia baccata	57	70	49	62	84
Rosa virginiana	52	64	41	77	72
Deschampsia flexuosa	50	25	21	54	18
Quercus prinoides	25	27	8	35	35
Hudsonia ericoides	46	35	5	27	54
Comptonia peregrina	19	22	18	35	20
Aster dumosus	47	68	69	58	72
Rubus flagellaris	43	55	74	50	47
Pinus rigida	41	30	44	46	18
Epigaea repens	29	40	23	23	55
Helianthemum dumosum	37	43	8	54	58
Viburnum dentatum	34	46	46	35	50
Solidago puberula	23	27	26	31	26
Hieracium venosum	38	38	8	19	61
Aronia arbutifolia	14	19	21	15	19
Helianthemum propinquum	33	35	10	31	50
Amelanchier nantucketensis	13	17	8	23	20
Vaccinium pallidum	10	11	18	19	4
Gaultheria procumbens	8	12	13	15	9
Panicum spp.	40	37	31	38	41
Corema conradii	8	4	3	8	3
Corylus cornuta	3	3	0	4	4
Solidago nemoralis	51	57	41	35	73
Chrysopsis falcata	51	42	10	38	61
Juncus greenei	43	55	62	54	53
Agrostis spp.	22	32	85	46	45
Euthamia tenuifolia	31	45	41	58	43

Table 1. Extended.

sandplain vegetation types identified in the column headings, including (top to bottom): Grasslands (I), Heathlands (II), HDN Sandplain Grasslands (A2b), Weedy Grasslands (A1), and Beach Grasslands (B2). The table includes only species that occurred in >25 percent of the relevés of at least one vegetation type, as well as a few taxa listed as endangered, threatened, or of special concern by the Massachusetts Natural Heritage and Endangered Species Program (1992).

B	B1	B2	II	C	C1	C2	D	D1	D2
Hg	HG	B	HL	LS	BB	BC	TS	HSO	MMS
84	93	70	69	76	79	71	64	74	45
74	93	42	81	82	88	71	81	91	62
98	100	94	84	100	100	100	73	94	34
66	91	24	54	75	79	65	42	56	17
83	79	91	25	35	35	35	19	26	7
61	61	61	62	53	56	47	67	67	69
80	86	70	62	78	79	76	52	72	14
79	84	70	90	98	97	100	86	98	62
52	80	3	57	63	65	59	54	76	14
45	71	0	77	76	79	71	77	89	55
36	52	9	87	76	74	82	93	94	90
31	45	9	58	31	26	41	75	65	93
88	80	100	58	86	91	76	41	52	21
20	30	3	63	63	50	88	63	80	31
64	73	48	57	75	74	76	46	61	17
13	18	6	52	55	47	71	51	57	38
13	21	0	43	31	26	41	49	52	45
25	32	12	43	25	24	29	53	41	76
58	50	73	41	80	79	82	17	22	7
10	16	0	36	27	15	53	41	50	24
27	39	6	33	37	32	47	30	39	14
16	25	0	31	20	29	0	37	37	38
18	29	0	31	39	35	47	25	39	0
37	48	18	29	29	35	18	29	41	7
8	13	0	26	20	15	29	30	28	34
30	46	3	25	31	32	29	22	30	7
7	11	0	25	24	18	35	27	24	31
9	14	0	25	27	24	35	24	31	10
2	4	0	22	22	15	35	23	35	0
45	39	55	21	39	35	47	10	13	3
15	14	15	20	51	26	100	1	2	0
2	4	0	10	8	6	12	12	7	21
42	59	12	16	24	26	18	11	13	7
65	61	73	11	14	21	0	10	15	0
22	30	9	4	0	0	0	6	6	7
9	11	6	3	0	0	0	5	2	10
8	13	0	15	8	12	0	19	13	31

Table 1. Continued

TWINSPAN Group	I	A	A1	A2a	A2b
Vegetation Type	GL	LB	W	PS	HDN
Potentilla canadensis	23	32	23	15	43
Rubus hispidus	28	40	49	19	42
Sisyrinchium fuscatum	15	22	3	8	36
Aster patens	17	21	3	23	30
Aster solidagineus	11	17	8	15	23
Linum intercursum	7	12	8	12	15
Aster concolor	1	2	0	0	4
Liatris scariosa	5	6	0	4	11
Baptisia tinctoria	28	37	41	42	32
Festuca ovina	37	44	72	38	31
Solidago rugosa	14	20	64	8	1
Festuca rubra	16	19	56	12	3
Rumex acetosella	28	35	46	35	28
Toxicodendron radicans	23	27	44	15	22
Poa pratensis	11	15	44	12	1
Anthoxanthum odoratum	11	15	41	4	5
Juniperus virginiana	14	14	41	8	3
Hypochoeris radicata	11	13	41	8	0
Prunus serotina	29	26	38	23	20
Cirsium pumilum	17	24	36	15	22
Potentilla simplex	14	21	36	19	14
Holcus lanatus	7	10	33	0	1
Hieracium piloselloides	6	9	28	4	1
Panicum virgatum	6	10	28	12	0
Solidago odora	15	14	26	23	5
Hypericum perforatum	9	10	26	4	4
Plantago lanceolata	5	8	23	0	3
Asclepias syriaca	4	6	23	0	0
Asclepias tuberosa	3	5	13	8	0
Carex umbellata	21	12	10	19	9
Ammophila breviligulata	21	12	5	23	12
Prunus maritima	19	9	5	27	5
Asclepias amplexicaulis	6	4	5	8	1
Solidago sempervirens	12	9	3	4	14
Hudsonia tomentosa	15	2	3	4	1
Polygonella articulata	11	4	0	4	5
Number of vascular species	26.5	29.6	32.8	26.4	29.0
Number of rare species	0.8	1.0	0.4	1.0	1.3
Number of non-native spp.	1.6	2.2	5.3	1.1	0.9
Number of ericaceous spp.	4.1	4.2	3.0	4.0	4.9
Number of other shrubs	4.6	5.0	6.1	5.2	4.4
Number of graminoid spp.	6.4	6.9	8.9	6.8	5.9
Number of forb species	11.4	13.5	14.8	10.3	13.8

Table 1. Extended, Continued.

B	B1	B2	II	C	C1	C2	D	D1	D2
Hg	HG	B	HL	LS	BB	BC	TS	HSO	MMS
8	13	0	10	6	9	0	13	17	7
9	13	3	19	4	3	6	28	30	24
4	7	0	5	4	6	0	6	7	3
11	18	0	15	18	21	12	13	15	10
1	2	0	1	2	0	6	1	2	0
0	0	0	1	0	0	0	1	2	0
0	0	0	1	0	0	0	1	0	3
2	4	0	8	6	3	12	10	13	3
15	20	6	18	24	12	47	14	19	7
26	32	15	3	4	6	0	2	2	3
3	2	6	2	0	0	0	4	6	0
11	5	21	1	2	3	0	0	0	0
18	14	24	1	0	0	0	1	2	0
17	14	21	1	2	3	0	1	2	0
3	5	0	1	2	3	0	0	0	0
3	4	3	1	0	0	0	1	2	0
13	13	15	2	2	3	0	2	4	0
8	4	15	0	0	0	0	0	0	0
35	30	42	12	14	21	0	11	7	17
4	5	3	4	4	6	0	5	4	7
3	5	0	3	0	0	0	5	6	3
1	2	0	0	0	0	0	0	0	0
1	2	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
16	13	21	4	4	6	0	5	7	0
7	9	3	2	2	3	0	2	4	0
1	2	0	1	0	0	0	1	0	3
1	2	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
35	16	67	4	10	15	0	1	2	0
34	16	64	5	10	12	6	2	2	3
35	21	58	14	12	12	12	16	7	31
10	2	24	2	6	9	0	0	0	0
17	4	39	1	2	3	0	0	0	0
35	7	82	1	2	3	0	0	0	0
21	4	52	1	4	6	0	0	0	0
21.7	23.2	19.2	19.4	20.9	20.9	20.8	18.5	20.9	14.1
0.5	0.7	0.2	0.9	1.2	0.8	1.8	0.7	0.8	0.5
0.8	0.8	0.8	0.1	0.1	0.2	0.0	0.1	0.1	0.1
4.0	4.4	3.2	5.3	5.7	5.2	6.7	5.1	5.9	3.4
4.0	4.2	3.7	4.7	4.5	4.5	4.6	4.8	4.7	5.0
5.6	5.8	5.3	3.3	4.1	4.3	3.8	2.8	3.2	2.0
8.2	8.8	7.0	6.1	6.5	7.0	5.6	5.8	7.0	3.7

of species that are encountered frequently within the coastal sandplain communities (Figure 2; Table 1). We have attached informal names that describe distinctive features of most groups, which also are distinguished by Roman numerals, letters, and numbers to differentiate hierarchical levels in the dichotomies.

Distinguishing grasslands and heathlands. The first TWINSPAN division separates the samples into two groups that reflect graminoid-dominated sandplain grasslands (Group I, with 228 relevés) and shrub-dominated heathlands (Group II, with 134 relevés). Three of the five species that occur most frequently in the grasslands are graminoids, including *Schizachyrium scoparium, Carex pensylvanica*, and *Danthonia spicata*, whereas four of the top five species in heathlands are woody, including *Quercus ilicifolia, Gaylussacia baccata, Arctostaphylos uva-ursi,* and *Vaccinium angustifolium*. Nevertheless, there is significant overlap in species composition between these communities; seven of the ten most frequent species in each community are the same, and these species occur in over 60 percent of the relevés. These include *A. uva-ursi, C. pensylvanica, S. scoparium, Q. ilicifolia, Aster linariifolius, Myrica pensylvanica,* and *V. angustifolium*.

Overall, the grasslands are considerably more species-rich than the heathlands; on average, 37 percent more species occur in the former (26.5 vs. 19.4 spp./relevé; Table 1). This richness is contributed largely by forbs, which are nearly twice as abundant in the grasslands than in the heathlands (11.4 vs. 6.1 spp./relevé; Table 1). Species considered to be endangered, threatened, or of special concern by the Massachusetts Natural Heritage and Endangered Species Program (1992) have similar frequencies in both grassland and heathland relevés, occurring in 58% and 57% of the relevés, respectively. Thirteen of the 22 endangered, threatened, special concern, or watch list species found in grasslands or heathlands in Massachusetts were encountered in the relevés (Table 2). Grasslands also tend to have more introduced species than heathlands (1.6 vs. 0.1 spp./relevé; Table 1). Of the 45 species of non-native taxa found in the relevés, only 10 occurred in heathlands, and all of these were much more abundant in grasslands. Relevés in Nantucket grasslands and heathlands tend to have more rare species (1.0 $\pm$ 0.9) than those from either Cape Cod or Martha's Vineyard (0.3 $\pm$ 0.5; 0.7 $\pm$ 0.7). They also tend

Table 2. Rare native plants occurring in coastal sandplain grasslands and heathlands. Species rank within Massachusetts (Mass. Nat. Her. & End. Spp. Prog. 1990, 1992): E = Endangered, T = Threatened, SC = Special Concern, WL = Watch List. Species preceded by > were present in relevés in this study. Occurrence data based on this study and personal records. G = Predominantly sandplain grasslands, H = Predominantly heathlands, G-H = Found in both grasslands and heathlands, ! = Exclusively in one community, * = Relevé occurrences predominantly in HDN Sandplain Grassland (Group A2b).

Species	Rank	Occurrence
Agalinis acuta (Sandplain Gerardia)	E	G!
>*Amelanchier nantucketensis* (Nantucket Shadbush)	SC	G-H
Aristida purpurascens (Purple Needlegrass)	T	G
Asclepias purpurascens (Purple Milkweed)	T	G
>*Asclepias tuberosa* (Butterflyweed)	WL	G
>*Aster concolor* (Eastern Silvery Aster)	E	G-H*
>*Cirsium horridulum* (Yellow Thistle)	WL	G-H*
>*Corema conradii* (Broom Crowberry)	SC	H
Panicum commonsianum (Commons' Panic-grass)	SC	G
Gnaphalium purpureum (Purple Cudweed)	E	G!
>*Helianthemum dumosum* (Bushy Rockrose)	SC	G-H
Hypericum stragulum (St. Andrew's Cross)	E	G-H
Lactuca hirsuta var. *sanguinea* (Hairy Wild-lettuce)	T	G
Lechea minor (Thyme-leaved Pinweed)	WL	G-H
>*Liatris scariosa* var. *novae-angliae* (New England Blazing-Star)	SC	G-H*
>*Linum intercursum* (Sandplain Flax)	SC	G*
>*Lupinus perennis* (Wild Lupine)	WL	G
>*Polygala nuttallii* (Nuttall's Milkwort)	WL	G
>*Quercus stellata* (Post Oak)	WL	G-H
>*Scleria pauciflora* (Papillose Nut-sedge)	E	G
>*Sisyrinchium fuscatum* (Sandplain Blue-eyed Grass)	SC	G*
Spiranthes vernalis (Early Ladies'-tresses)	SC	G

to have fewer non-native species (0.4 ± 0.7 vs. 2.4 ± 3.7 on Cape Cod, and 2.4 ± 2.9 on Martha's Vineyard).

The abundance of shrubs, particularly heath species, in the grasslands is noteworthy. There is little difference between grasslands and heathlands in terms of the average number of ericads (4.1 vs. 5.3 spp./relevé; Table 1) or other shrubs (4.6 vs. 4.7). Comparisons of the percentage of relevés in which many of the smaller heath species occur illustrate this. Species such as *Arctostaphylos uva-ursi* (76 vs. 84%), *Vaccinium angustifolium* (61 vs. 77%), and *Hudsonia ericoides* (46 vs. 57%) are similarly com-

Table 3. Characteristics of grassland and heathland soils on Nantucket. Only vegetation types from which soil samples were collected are included. Values ± 1 SD.

	n	pH	Sand (%)	Clay (%)
GRASSLANDS				
All grasslands (Group I)	44	3.52 ± 0.20	90.4 ± 5.8	4.4 ± 1.9
Pennsylvania Sedge GL (Group A2a)	24	3.55 ± 0.20	88.8 ± 7.0	5.0 ± 1.8
HDN Sandplain GL (Group A2b)	12	3.55 ± 0.15	89.7 ± 1.4	5.2 ± 0.8
Heathy Grassland (Group B1)	8	3.37 ± 0.21	96.3 ± 0.4	1.7 ± 1.0
HEATHLANDS				
All heathlands (Group II)	36	3.30 ± 0.24	91.0 ± 4.5	4.3 ± 0.8
Low Shrub (Group C)	8	3.17 ± 0.22	92.5 ± 2.7	3.8 ± 0.3
Huckleberry-Scrub Oak (Group D1)	28	3.35 ± 0.24	90.6 ± 5.0	4.4 ± 0.8

mon in both vegetation types. However, the dominance of taller shrub species in heathlands is pronounced, as demonstrated by the percent frequencies of several taxa in grasslands versus heathlands: *Quercus ilicifolia* (63 vs. 90%), *Gaylussacia baccata* (57 vs. 87%), *Quercus prinoides* (25 vs. 63%), *Comptonia peregrina* (19 vs. 52%), and *Aronia arbutifolia* (14 vs. 26%). This pattern also is reflected in another measure, the average of dominance values, which is generally higher for these shrubs in the heathlands (e.g., *Gaylussacia baccata* (d.v. = 2.2 vs. 3.2), *Quercus ilicifolia* (d.v. = 1.5 vs. 2.3).

Samples collected from Nantucket suggest that heathland soils tend to be more acidic (pH 3.30 vs. 3.52, $p < 0.005$) and have higher organic C:N ratios (31.5 vs. 24.8, $p < 0.005$) than grasslands (Table 3).

Types of sandplain grasslands. Within the group of grassland relevés (Figure 2; Table 1), the first dichotomy separates those in which *Deschampsia flexuosa* is a major component (Group B–Hairgrass Grasslands) from those in which *Schizachyrium scoparium* is the primary dominant grass (Group A–

Table 3. Extended.

Silt (%)	Mg (ppm)	Ca (ppm)	Na (ppm)	K (ppm)	C:N
5.3 ± 4.1	6.3 ± 4.0	19.0 ± 14.0	2.7 ± 1.6	6.9 ± 3.9	24.8 ± 4.7
6.2 ± 5.5	6.2 ± 4.0	16.9 ± 13.0	2.8 ± 1.8	7.3 ± 4.3	24.4 ± 5.4
5.1 ± 1.0	6.4 ± 4.4	15.1 ± 10.8	3.2 ± 1.2	7.0 ± 3.4	23.3 ± 2.4
3.0 ± 0.0	6.2 ± 3.5	30.3 ± 17.2	1.6 ± 0.7	5.3 ± 3.1	28.2 ± 3.0
5.9 ± 4.5	7.0 ± 4.1	23.5 ± 16.7	2.5 ± 1.1	7.1 ± 3.7	31.5 ± 4.6
3.7 ± 2.4	9.2 ± 4.0	36.3 ± 19.2	2.8 ± 0.9	9.1 ± 3.4	34.4 ± 4.3
6.5 ± 4.9	6.9 ± 4.8	22.5 ± 20.1	2.3 ± 1.1	6.4 ± 3.6	30.1 ± 4.4

Little Bluestem Grasslands). Although *Schizachyrium scoparium* is common in both groups (84% in Group B vs. 96% in Group A), *Deschampsia flexuosa* is not (88% in Group B vs. 25% in Group A). In general, the Hairgrass Grasslands tend to have fewer vascular species than the Little Bluestem Grasslands (21.7 vs. 29.6 spp./relevé), a pattern which is most noticeable among the forbs (8.2 vs. 13.5 spp./relevé). The frequencies of many rare species also are lower in the Hairgrass Grasslands: *Sisyrinchium fuscatum* (4 vs. 22%), *Helianthemum dumosum* (27 vs. 43%), *Amelanchier nantucketensis* (7 vs. 17%), *Linum intercursum* (0 vs. 12%), *Asclepias tuberosa* (0 vs. 5%), and *Liatris scariosa* var. *novae-angliae* (2 vs. 6%). Hairgrass Grasslands are well represented on Cape Cod and Nantucket, but appear to be scarce on Martha's Vineyard, where two relevés were collected of this type (Table 4).

Many Hairgrass Grasslands are dominated by a mixture of graminoids and heath species. The TWINSPAN dichotomy that subdivided Group B distinguished a large subgroup of relevés, termed Heathy Grasslands (Group B1; Figure 2; Table 1), that had high frequencies of grasses (*Schizachyrium scoparium*–93%;

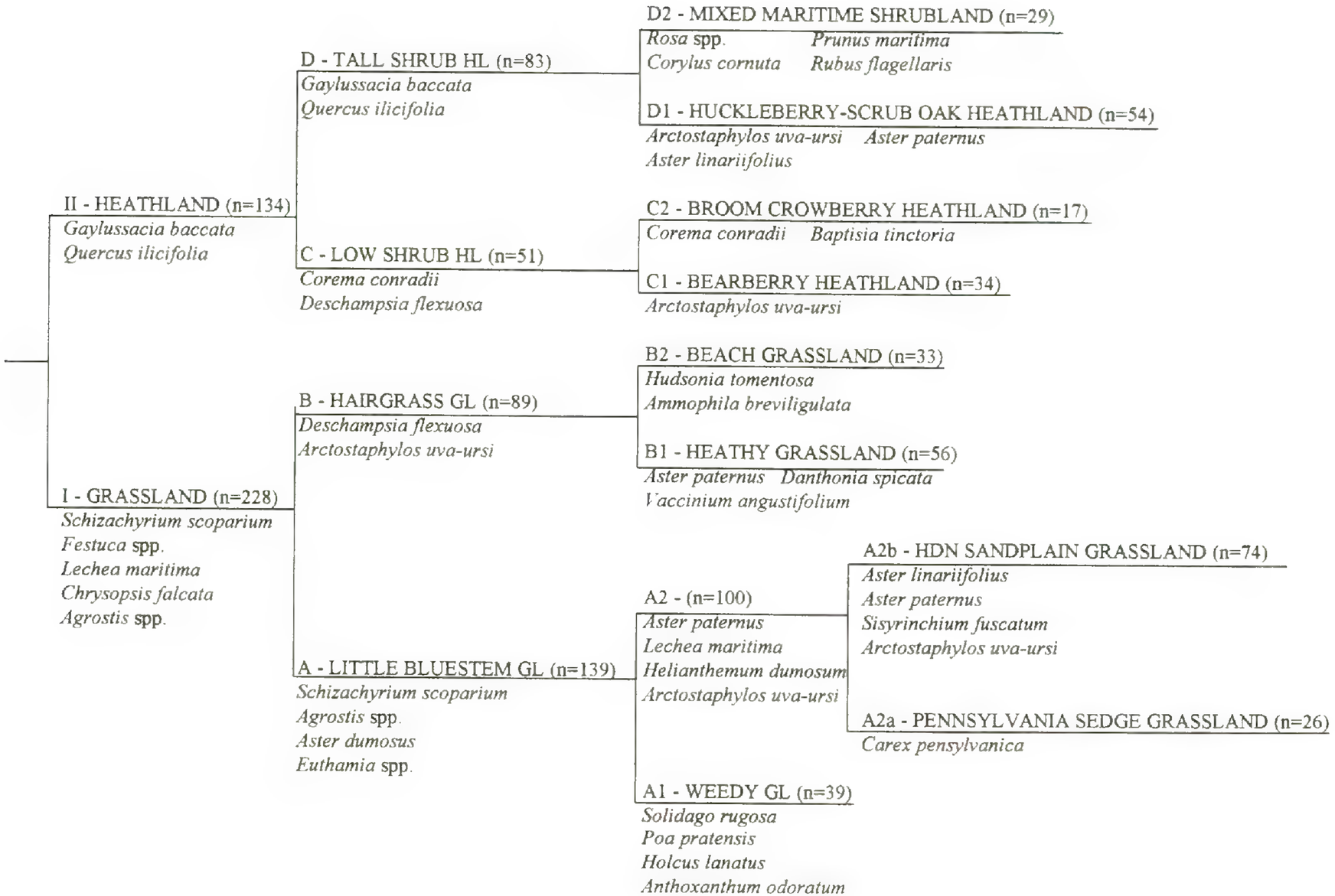
I - GRASSLAND (n=228)
Schizachyrium scoparium
Festuca spp.
Lechea maritima
Chrysopsis falcata
Agrostis spp.
II - HEATHLAND (n=134)
Gaylussacia baccata
Quercus ilicifolia
A - LITTLE BLUESTEM GL (n=139)
Schizachyrium scoparium
Agrostis spp.
Aster dumosus
Euthamia spp.
B - HAIRGRASS GL (n=89)
Deschampsia flexuosa
Arctostaphylos uva-ursi
C - LOW SHRUB HL (n=51)
Corema conradii
Deschampsia flexuosa
D - TALL SHRUB HL (n=83)
Gaylussacia baccata
Quercus ilicifolia
A1 - WEEDY GL (n=39)
Solidago rugosa
Poa pratensis
Holcus lanatus
Anthoxanthum odoratum
A2 - (n=100)
Aster paternus
Lechea maritima
Helianthemum dumosum
Arctostaphylos uva-ursi
A2a - PENNSYLVANIA SEDGE GRASSLAND (n=26)
Carex pensylvanica
A2b - HDN SANDPLAIN GRASSLAND (n=74)
Aster linariifolius
Aster paternus
Sisyrinchium fuscatum
Arctostaphylos uva-ursi
B1 - HEATHY GRASSLAND (n=56)
Aster paternus Danthonia spicata
Vaccinium angustifolium
B2 - BEACH GRASSLAND (n=33)
Hudsonia tomentosa
Ammophila breviligulata
C1 - BEARBERRY HEATHLAND (n=34)
Arctostaphylos uva-ursi
C2 - BROOM CROWBERRY HEATHLAND (n=17)
Corema conradii Baptisia tinctoria
D1 - HUCKLEBERRY-SCRUB OAK HEATHLAND (n=54)
Arctostaphylos uva-ursi Aster paternus
Aster linariifolius
D2 - MIXED MARITIME SHRUBLAND (n=29)
Rosa spp. Prunus maritima
Corylus cornuta Rubus flagellaris

Table 4. Summary of relevés by vegetation type from Nantucket, Cape Cod, and Martha's Vineyard. % = Number of relevés in each vegetation type sampled in a particular region divided by the total number of relevés sampled in all regions for that vegetation type.

	Nantucket (n = 243)		Cape Cod (n = 91)		Martha's V. (n = 28)		Total (n = 362)
	No.	%	No.	%	No.	%	No.
Heathland (Group II)	116	87	16	12	2	1	134
Tall Shrub (Group D)	81	98	0	0	2	2	83
Mixed Maritime (Group D2)	29	100	0	0	0	0	29
Huckleberry-Scrub Oak (Group D1)	52	96	0	0	2	4	54
Low Shrub (Group C)	35	69	16	31	0	0	51
Broom Crowberry (Group C2)	14	82	3	18	0	0	17
Bearberry (Group C1)	21	62	13	38	0	0	34
Grassland (Group I)	127	56	75	33	26	11	228
Hairgrass (Group B)	41	46	46	52	2	2	89
Beach (Group B2)	0	0	31	94	2	6	33
Little Bluestem (Group A)	86	62	29	21	24	17	139
HDN Sandplain (Group A2b)	70	95	0	0	4	5	74
Pennsylvania Sedge (Group A2a)	15	58	7	27	4	15	26
Weedy (Group A1)	1	3	22	56	16	41	39

Carex pensylvanica–93%; *Danthonia spicata*–91%; *Deschampsia flexuosa*–80%), ericoids (*Arctostaphylos uva-ursi*–100%; *Hudsonia ericoides*–73%; *Vaccinium angustifolium*–71%), and other common heathland plants. Soil samples from sites within this subgroup (Group B1; Table 3) are significantly sandier, have a lower pH, and have lower exchangeable Mg:Ca and Na:K ratios than the other grasslands ($p < 0.005$).

The other branch of the Hairgrass Grassland dichotomy identified a smaller subgroup of relevés we termed the Beach Grasslands (Group B2; Figure 2; Table 1). These grasslands often occur close to the coast in areas that receive some input of eolian sand

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Figure 2. TWINSPAN dendrogram of coastal sandplain relevé groupings. Informal names describe major distinguishing features of grassland (GL) and heathland (HL) vegetation types. Species identified by TWINSPAN to be "indicator species" are listed under each dichotomy. (n = number of relevés comprising group).

and usually include such species as *Ammophila breviligulata* (64%), *Hudsonia tomentosa* (82%), *Lechea maritima* (91%), and several species of *Cladonia* and *Cladina* lichens. This group had the lowest diversity of any of the grassland types and generally did not contain any rare species.

Little Bluestem Grasslands (Group A) include several types of coastal sandplain vegetation that were distinguished in the TWINSPAN ordination. Weedy Grasslands (Group A1) are characterized by the greatest number of non-native species, with an average of 5.3 spp./relevé (16% of the vascular plants), compared to 1.6 spp./relevé (6% of the vascular plants) for all grasslands (Group I). Common non-native species include grasses such as *Festuca ovina* (72%), *Anthoxanthum odoratum* (41%), *Poa pratensis* (44%), *Holcus lanatus* (33%), and *Phleum pratense,* and forbs such as *Hypochoeris radicata* (41%), *Rumex acetosella* (46%), *Hieracium piloselloides* (28%), and *Hypericum perforatum* (26%). Weedy Grasslands also tend to have fewer heath species than any other grasslands (3.0 vs. 4.1 ericads/relevé). Two native grasses, *Schizachyrium scoparium* and *Agrostis* species, are also common. These grasslands are frequent on Cape Cod and Martha's Vineyard, but only one of the Nantucket relevés was of this type (Table 4).

The dichotomy that distinguished subgroups within the Little Bluestem Grasslands contrasted the Weedy Grassland samples with a group of relevés (Group A2) that is noteworthy for the presence of *Helianthemum dumosum,* a species listed as "Special Concern" in Massachusetts (Mass. Natural Heritage and Endangered Species Program 1992). This species is found in both coastal grasslands and heathlands, and occurred in over 50% of the relevés in this group. Group A2, which might be considered as the "non-weedy" Little Bluestem Grasslands, is best described by examining the two distinct subgroups of which it is comprised. Group A2a, Pennsylvania Sedge Grasslands, contains abundant *Carex pensylvanica,* occurring in 100 percent of the relevés with an average d.v. = 3.7. This type is more common on Nantucket and Cape Cod, with only a couple of locations sampled on Martha's Vineyard (Table 4). The second group (Group A2b) includes the largest number of native grassland species (28 spp./relevé), the most rare species (1.3 spp./relevé), and the fewest non-native species (0.9 spp./relevé) in any of the Little Bluestem Grasslands. We refer to it as High Diversity Native (HDN) Sandplain Grass-

land, because it provides the most diverse expression of the native grasslands, with a rich flora of rare species and few introduced taxa. In addition to the greater dominance of *Carex* in Group A2a than in Group A2b, these two grassland types also can be distinguished from one another by the greater frequency of ericads (4.9 vs. 4.0 spp./relevé) and forbs (13.8 vs. 10.3 spp./relevé) in the HDN Sandplain Grasslands. This type was found most frequently on Nantucket, with only a few examples on Martha's Vineyard, and none on Cape Cod (Table 4).

Types of coastal heathlands. The first dichotomy within the heathland relevés (Figure 2; Table 1) separates those dominated by tall (>0.7 m) shrubs (Group D–Tall Shrub Heathlands) from others that are generally of low stature (Group C–Low Shrub Heathlands). *Gaylussacia baccata* and *Quercus ilicifolia* are common in both groups, but both are more dominant in Group D (d.v. = 3.7 and 2.6) than in Group C (d.v. = 2.3 and 1.9). Most other tall shrubs found in these coastal habitats, including such species as *Rosa virginiana* and *Rubus flagellaris,* also occur with a greater frequency in Tall Shrub Heathlands than in any other types.

Tall Shrub Heathlands (Group D) are divided into Mixed Maritime Shrublands (Group D2) and Huckleberry-Scrub Oak Heathlands (Group D1). The samples in our study come primarily from Nantucket, although both vegetation types occur frequently throughout the coastal sandplains of Cape Cod and Martha's Vineyard. Many tall, non-ericaceous species are found most frequently in Group D2, including *Aronia arbutifolia, Corylus cornuta, Prunus maritima,* and *Rubus flagellaris.* This group tends to be the most species-poor of all heathlands (14.1 spp./relevé) and contains the lowest numbers of ericads (3.4 spp./relevé), graminoids (2.0 spp./relevé), and forbs (3.7 spp./relevé). Unlike other heathland types, where *Quercus ilicifolia* occurs in >86% of the relevés, oak is much less frequent in Mixed Maritime Shrublands (62%). As the name implies, Mixed Maritime Shrublands are extremely variable in composition; quite different associations of shrub species may be lumped into this group. In many places, they probably would not be considered to be types of heathlands. However, the relevés that comprise Group D2 mostly include *Gaylussacia baccata* and *Vaccinium angustifolium* as dominants, and thus are arguably heathlands. The other Tall Shrub Heathland subtype, the Huckleberry-Scrub Oak Heathlands (Group D1), is

noteworthy in having the greatest dominance of both *Quercus ilicifolia* (d.v. = 2.8) and *Gaylussacia baccata* (d.v. = 3.7) of any heathland type. In some cases, this type approaches the composition, structure, and appearance of many scrub oak barrens.

The other main group of heathlands, Low Shrub Heathlands (Group C), is dominated by *Arctostaphylos uva-ursi* (100% frequency, d.v. = 3.6), *Hudsonia ericoides* (75%, d.v. = 2.4), and a diversity of other low ericoid shrubs, such as *Corema conradii* and *Vaccinium angustifolium*. Compared to the Tall Shrub Heathlands, both grasses (4.1 vs. 2.8 spp./relevé) and forbs (6.5 vs. 5.8 spp./relevé) are more frequent in this vegetation type. Low Shrub Heathlands are well developed on Nantucket and Cape Cod, but are infrequent on Martha's Vineyard (Table 4).

Low Shrub Heathlands were divided into two types. *Arctostaphylos uva-ursi* is extremely dominant (d.v. = 3.9) in the Bearberry Heathlands (Group C1). Although bearberry occurs in most heathlands and many grasslands, it reaches its greatest abundance in this type. Many examples exist within the Cape Cod National Seashore and on Nantucket. Broom Crowberry Heathlands (Group C2) have many of the same species as Bearberry Heathlands, but are strongly dominated by the rare shrub *Corema conradii* (100%, d.v. = 4.0). This vegetation type is most common on Cape Cod, with several sites on Nantucket (Table 4).

DISCUSSION

The results of a TWINSPAN classification of relevés from grasslands and heathlands on Cape Cod, Martha's Vineyard, and Nantucket highlight the compositional variability of the shrub, grass, and forb-dominated vegetation types found in this region. The fact that seven of the ten most frequent taxa are shared by both communities emphasizes the degree of overlap in these vegetation types. While some sites are relatively distinct, others incorporate so many taxa from both communities that it may be arbitrary into which type they are classified.

The inclusion of samples from other coastal grasslands and heathlands in the Northeast would further clarify the taxa that define the communities described in this classification. Data from such well-known sites as the Hempstead Plains and Montauk in New York (Taylor 1923; Conard 1935; Reschke 1990), as well as lesser-known examples from Rhode Island and Connecticut,

would likely expand the number of types beyond those we have described. Even within Massachusetts, some types were not represented in our samples, including the *Panicum virgatum* grasslands of Noman's Land and Cuttyhunk (Elizabeth Islands) and the *Smilax-Gaylussacia* heathlands and *Myrica pensylvanica* shrublands elsewhere in the Elizabeth Islands (pers. obs.).

The distribution and extent of grasslands and heathlands on Nantucket, Martha's Vineyard, and Cape Cod can be evaluated from various vegetation maps of these areas (Harshberger 1914; Robertson 1973; MacConnell et al. 1984; Nature Conservancy 1995). However, the different vegetation types identified in these studies make it difficult to compare the grassland and heathland types we describe. On 1980 aerial photos, MacConnell et al. (1984) delineated "heath plant community" acreages that amounted to about 576 ha on Cape Cod, 280 ha on Martha's Vineyard, and 3638 ha on Nantucket. Their definition appears to have lumped most of the grassland and heathland vegetation types we sampled. MacConnell et al.'s Nantucket figure compares favorably with a total of 3239 ha reported in a GIS study by The Nature Conservancy (1995) based on 1978 aerial photographs.

Although our selection of relevé sites was neither random nor exhaustive, we collected data from most major native grasslands and heathlands on Cape Cod, Martha's Vineyard, and Nantucket (Dunwiddie et al. 1993). The number of relevés sampled in each of the three regions is similar to the relative acreages reported by MacConnell et al. (1984). Thus our relevé data from different vegetation types, summarized by region (Table 4), may provide a general indication of the occurrence and abundance of these communities in southeastern Massachusetts. These data suggest that most types of grassland and heathland are found throughout the areas sampled, but that significant regional variation exists. For example, the grassland type with the greatest concentration of rare species (HDN Sandplain Grassland, Group A2b) occurs primarily on Nantucket. Weedy Grasslands (Group A1), in contrast, are more prevalent on Cape Cod and Martha's Vineyard. Hairgrass Grasslands appear most frequently on Cape Cod, and are uncommon on Martha's Vineyard.

The great variability in the composition and distribution of these communities presents an intriguing and difficult problem in understanding the origin, maintenance, and dynamics of the coastal sandplain vegetation. Why grasslands develop in some

areas while heathlands and maritime shrublands predominate in others, or why some sites appear to be relatively stable while others succeed to forests within a few decades, are questions that may have several answers in different places. A combination of factors probably is important in most areas, including differences in climate, substrate, disturbance and land use history, and initial floristic composition.

Proximity to the ocean was considered as one factor that might affect the distribution of vegetation types. Wind and salt spray play an evident role in suppressing arboreal species near the coast (Boyce 1954), which may explain the prevalence of both grasslands and heathlands within a few miles of the shoreline. However, we could find no clear relationship between the occurrence of different vegetation types identified in our study and their distance from the ocean. For example, Bearberry Heathlands are abundant on coastal bluffs on Cape Cod, while Little Bluestem Grasslands flourish close to the Nantucket shore. Only the Beach Grassland (Group B2) showed a tendency to occur primarily within a few hundred meters of the shore.

We also examined whether grassland and heathland types occur preferentially on different substrates. However, a categorization of sites as located on either glacial moraine or outwash revealed no correlation; the different vegetation types occur on both types of deposits. Comparisons of soils collected from some Nantucket grasslands or heathlands showed no significant differences in available cations or particle size (Table 3), also suggesting that underlying parent material composition is not controlling the distribution of these vegetation types. Additional soil samples from Cape Cod, Martha's Vineyard, and other coastal grassland and heathland sites are needed to determine whether these patterns can be generalized throughout the region.

Several differences in soil characteristics are worth noting. The significantly higher organic C:N ratios in heathland soils than in grasslands may largely result from biotic activity. Grassland species tend to have a higher percent N in tissues (lower C:N ratio), generally producing soils with relatively high exchangeable N; perennial woody species often produce litter with a lower percent N in tissues, giving rise to soils with a higher organic C:N ratio and lower N availability.

Within the grassland samples, the data provide some evidence that the occurrence of at least one of the grassland types may

relate to soil parameters. The samples from the Heathy Grasslands subgroup (Group B1) are significantly sandier, more acid, and have lower Mg:Ca and Na:K ratios than the other grassland samples. The other grassland type in the Hairgrass group (Beach Grasslands, Group B2) might also be expected to have a similar pattern of occurrence on droughty, low nutrient soils. Both of these grassland types have lower species diversity than the relatively species-rich Little Bluestem Grasslands.

Our results suggest that substrate and geographic location play roles in the distribution of some of the coastal vegetation types. However, clear environmental correlates do not emerge to explain many of the patterns of grassland and heathland distribution we observed. Instead, we hypothesize that much of the variation in composition and distribution of coastal sandplain grasslands and heathlands reflects differences in the disturbance and successional histories of sites, rather than resulting from differences in the physical or environmental characteristics of sites. According to this hypothesis, the mosaic of current vegetation on the coastal sandplain documented in our relevés is largely attributable to disturbances of different types and intensities occurring at different times and frequencies. Each disturbance acts upon a unique assemblage of species that is continually reshaped at each site. A similar situation has been described in midwestern prairies, where sites that have a recent history of fire and grazing support different communities than comparable sites where these disturbances are absent (Curtis 1959).

This hypothesis needs to be examined using sites with a long and detailed land use history. Such an examination would be difficult, however, as most grasslands and heathlands in southeastern Massachusetts are many decades removed from the period when grazing, fires, and agriculture were actively shaping the vegetation. Records of 18th and 19th century fires, land use, and vegetation that are tied to specific sites are scant, and were unobtainable for most of our relevé sites. While it is likely that all of these coastal sites received some degree of livestock grazing during the last 300 years, plowing histories may differ considerably between locations. Unfortunately, we did not collect data on the presence of plow horizons and other evidence of past soil tillage.

In the absence of detailed, site-specific land use histories for the relevé sites, we have drawn upon photographic studies on Nantucket (Dunwiddie 1992), Martha's Vineyard (Dunwiddie

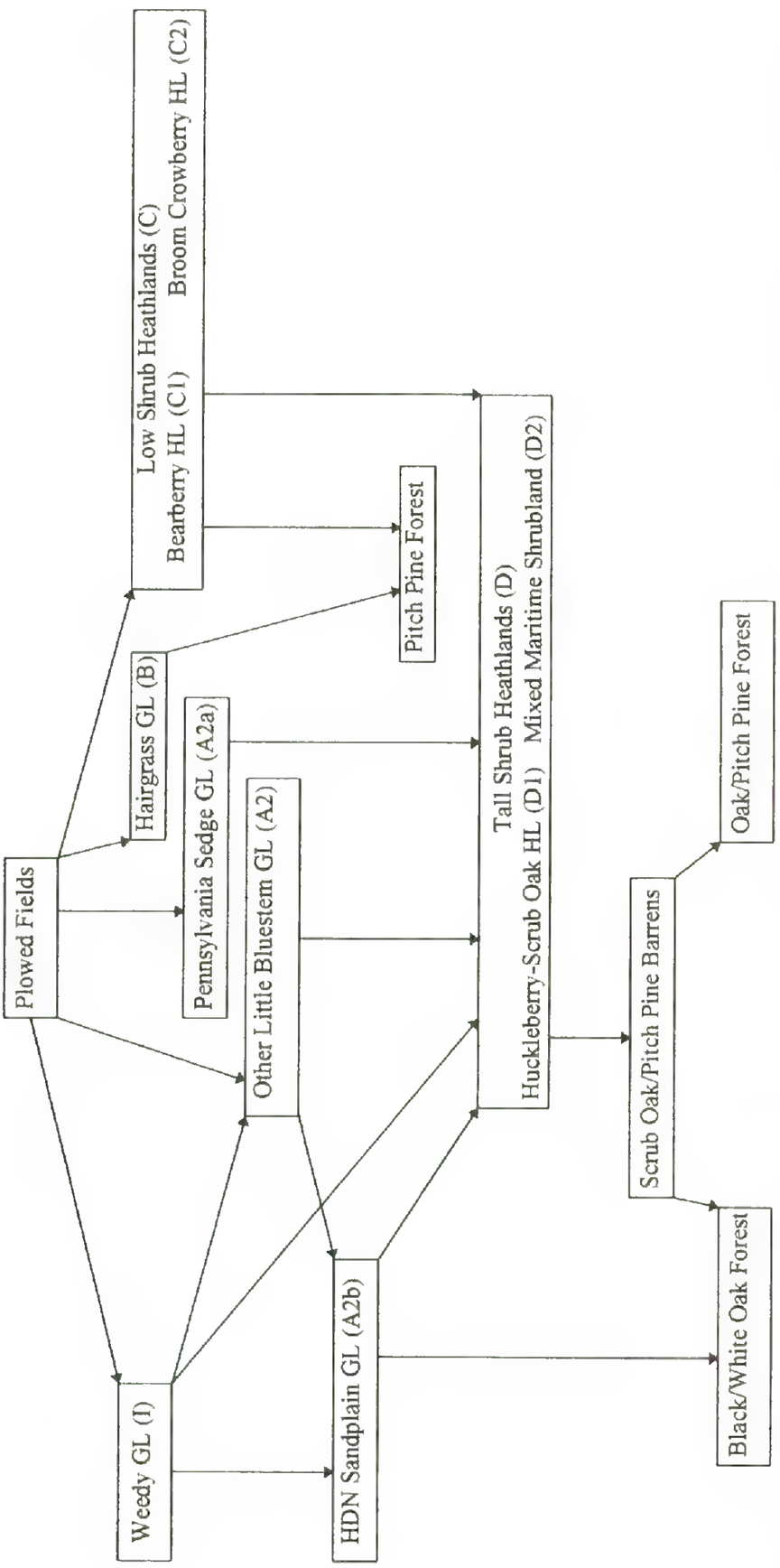

Figure 3. Proposed successional relationships of major coastal sandplain vegetation types. GL = Grassland; HL = Heathland.

1994), and Cape Cod (Dunwiddie and Adams 1994) to provide anecdotal information on how different vegetation types have changed over time in this region. Combining this information with our observations of the distribution of sites and a regional knowledge of past land use, we developed a model of the successional relationships among coastal vegetation types (Figure 3).

Agriculture was widespread throughout the coastal sandplain, and many sites no doubt were plowed, at least for a while. Thus our model depicts several successional pathways beginning with plowed fields. Factors that determine which pioneering communities develop on bare ground may include the type and extent of disturbance creating the bare ground, the composition of both the prior and surrounding vegetation, the current land use, and differences in substrate. For example, many agricultural fields and improved pastures develop into some form of the Weedy Grassland (Group A1), especially if they have received additions of lime and fertilizer and have been cultivated for sufficient time to eliminate much of the native seed bank. These areas may increasingly resemble the other Little Bluestem Grassland types (Group A2) if sources of native seed are available, and fires, salt spray, grazing, or other factors prevent extensive shrub encroachment. Otherwise, they may succeed to various Tall Shrub Heathlands (Group D).

Weedy Grasslands are less likely to develop in agricultural sites that received little or no nutrient or lime amendments and in pastures that were created by clearing open woodland or shrubland and were never plowed. Instead, these sites may develop

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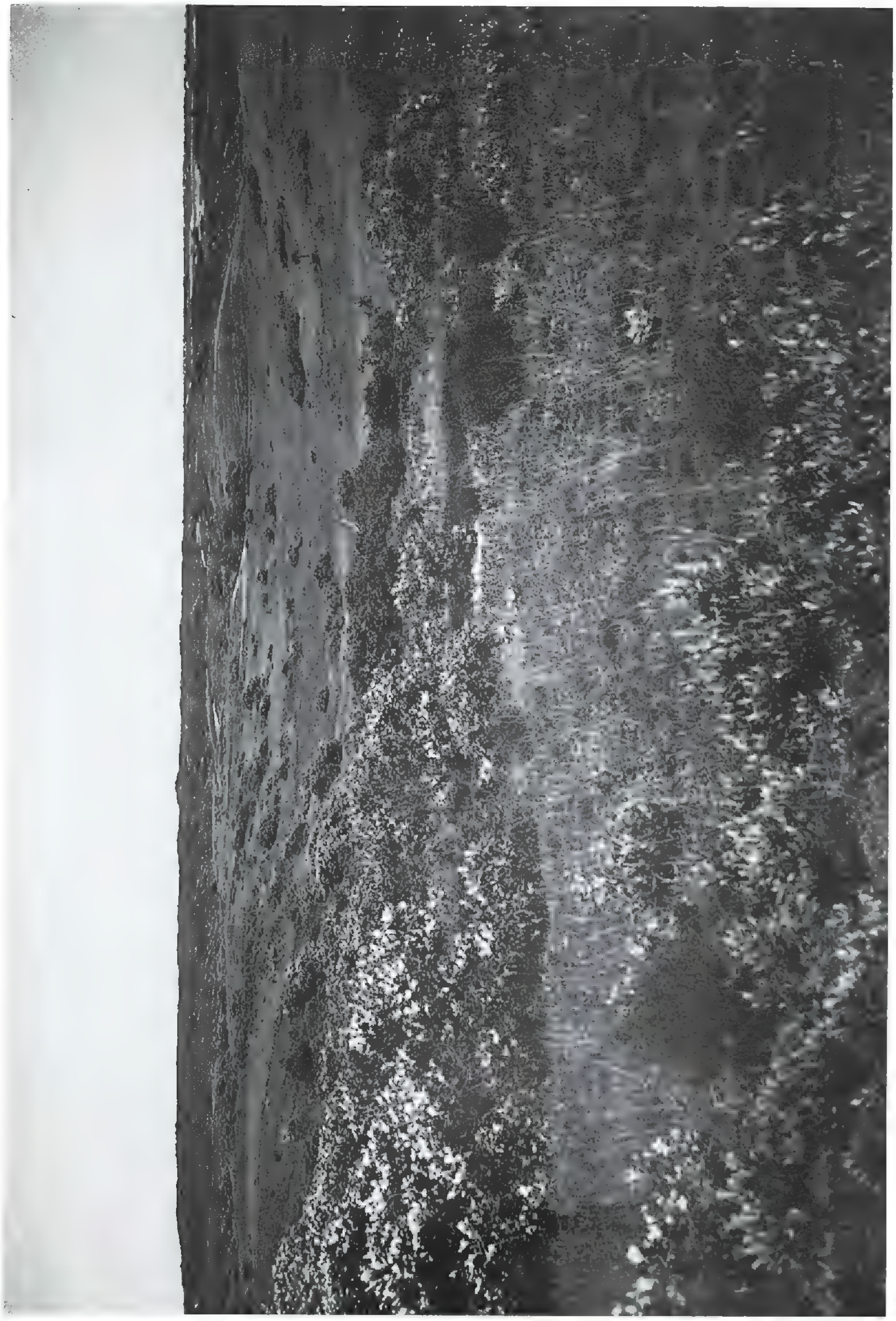
Figure 4. (a) The intermingling of sandplain grassland and heathland vegetation on Nantucket is visible in the photograph, taken about 1890. Light areas are dominated by *Deschampsia flexuosa* and *Schizachyrium scoparium*. Small dark cushions in the foreground are *Hudsonia ericoides*; dark patches in the distance are primarily *Gaylussacia baccata* clones. Heavy grazing by sheep and other livestock had declined in this area about 40 years earlier, although occasional animals may have continued to graze when this photo was taken (reprinted courtesy of the Nantucket Historical Association). (b) Photograph taken from the same location a century later, showing an increase in taller woody plants, especially *Quercus ilicifolia*. Many areas of Nantucket, Cape Cod, and Martha's Vineyard have experienced much more rapid succession of shrubs and trees into the grasslands and heathlands than depicted in these photographs.



other types of grassland or Low Shrub Heathland. Old photographs and some contemporary examples of unimproved grazing land on Nantucket, Martha's Vineyard, and the Elizabeth Islands suggest that they frequently develop into types of Little Bluestem Grassland (Group A; Dunwiddie 1992, 1994). The high diversity HDN Sandplain Grasslands (Group A2b) may develop from these sites if they are not overtaken by woody plants. On Cape Cod, Hairgrass Grasslands (Group B) appear to have developed more frequently in pastured land than in the other locales. It is not clear under what conditions the Pennsylvania Sedge dominated (Group A2a) type develops, although it may be related to particularly heavy grazing. The high organic C:N ratios observed in Low Shrub Heathlands suggest that nitrogen may be particularly limiting in these sites; Broom Crowberry (Group C2) and Bearberry Heathlands (Group C1) often appear to develop in areas where the topsoil is removed, and the subsoil is widely exposed.

Tall Shrub Heathlands (Group D) develop from both grasslands and Low Shrub Heathlands (Group C; Figure 4). The factors that determine which of the different tall shrub vegetation types may develop are unclear, although seed availability and land use history probably play major roles. Huckleberry-Scrub Oak Heathland (Group D1) often replaces Low Shrub Heathland, but where it succeeds grassland types, low ericaceous shrubs are generally already common. Mixed Maritime Shrublands (Group D2) often develop from grasslands and less often from Low Shrub Heathlands.

In some cases, tall shrub stages may be bypassed and succession directly to forest can occur. Many of the pitch pine forests on Cape Cod are replacing Low Shrub Heathlands and Hairgrass Grasslands (Dunwiddie and Adams 1994). On Martha's Vineyard, forests of black, white, and post oaks have developed in Little Bluestem Grasslands in many areas during the last 80–100 years, with no intervening shrub stage (Dunwiddie 1994). The loss of grassland and heathland to scrub oak, pitch pine, and other taller woody plant associations often is very rapid (Dunwiddie 1992). MacConnell et al. (1984) reported a 30 percent loss of heathland on Martha's Vineyard and Nantucket between 1951 and 1971 as a result of succession of these species.

Our model does not attempt to describe disturbances that arrest or reverse succession. Such events usually would correspond to a different set of arrows in the reverse direction in Figure 3. While

the model begins with plowed fields, succession following other disturbances, such as fire, livestock grazing, and forest clearance, is also likely to follow similar pathways. However, the starting point of these successional sequences would vary, depending on the initial species composition and the nature of the disturbance.

Most of the maritime grasslands and heathlands of southeastern Massachusetts are dominated by native species, including a diversity of rare taxa. In many places, these vegetation types may have been created by plowing or grazing. In other cases, agricultural practices modified the composition of existing natural grasslands or heathlands. Today, many organizations are focusing their efforts on preserving the remaining examples of these vegetation types. The classification presented here provides a means of identifying more clearly how particular sites compare to the compositional range of grasslands and heathlands in the region. Furthermore, it can provide the basis for ranking sites to establish priorities for acquisition and management (Dunwiddie et al. 1993).

ACKNOWLEDGMENTS. Partial funding for this project was provided by a grant from the Massachusetts Natural Heritage and Endangered Species Program. P. Swain, T. Chase, R. Johnson, and T. Simmons helped in many ways to facilitate field work. We would also like to thank K. Lajtha for assisting with the soil analyses. T. Simmons and other participants at a Nature Conservancy-sponsored workshop provided useful ideas on the successional model.

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RHODORA, Vol. 98, No. 894, pp. 146–167, 1996

THE VASCULAR FLORA OF HOPEWELL CULTURE NATIONAL HISTORICAL PARK, ROSS COUNTY, OHIO

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ABSTRACT. Hopewell Culture National Historical Park, a unit of the United States National Park Service located in Ross County in south central Ohio, was created to restore, protect, and interpret the legacy of the mound building Hopewell prehistoric peoples. The vascular flora of the park had been estimated to be only 20% known prior to the undertaking of this project. During the spring, summer, and fall of 1995, almost 700 plant specimens were collected by three investigators from five units of the park. Totals of 438 species, 281 genera, and 93 families of vascular plants were discovered, representing 40% of the flora of Ross County, and 17% of the flora of Ohio. Introduced species constituted 32% of the flora. Sixty-five species are new records for Ross County. Two species of special concern, *Spiranthes ovalis* and *Eleocharis ovata*, are on the state's threatened and endangered species list. The Hopewell unit had the highest plant diversity of the five units.

Key Words: Hopewell, national park, flora, vascular plants

Hopewell Culture National Historical Park is a unit of the United States National Park Service located in Ross County in south central Ohio. It was created to restore, protect, and interpret the legacy of the mound building Hopewell, a group of prehistoric Native American peoples and cultures existing approximately 2,200 to 1,500 years ago. The park is nationally significant because it contains some of the few remaining Hopewell earthworks in the world. However, it also contains areas of land with natural vegetation. Prior to this study, three partial plant checklists and some plant specimens in the park herbarium constituted the knowledge on plant species in the park. As of 1994, about 85 plant species had been recorded in the park and this was estimated to be about 20% of the total probably present (Allison Cusick, Ohio Department of Natural Resources, pers. comm.). This made the park's flora the least known flora of any national park in the midwestern region (Bennett 1996). Recent floristic work in the region includes the flora of unglaciated southeastern Ohio, including Ross County (Cusick and Silberhorn 1977), and a flora of Fort Hill State Memorial in adjacent Highland County (Braun

1969). The current study aimed to increase knowledge of the park's flora with the following goals in mind: (1) to investigate the presence of federally and/or state listed threatened and endangered species, (2) to gain a better understanding of the park's habitats and floristic diversity, (3) to document biodiversity information to assist future park management, and (4) to contribute to the knowledge of Ohio's flora and the floras of parks in the midwestern U.S.

Hopewell Culture park and Ross County are situated on a major dividing line running NE/SW between two phytogeographic regions in Ohio: " . . . the Miami region, mainly a calcareous, glaciated till plain" to the northwest of the park, and the " . . . southern non-glaciated area of the Allegheny Plateau" to the southeast (Braun 1989). This latter area contains an older and more relatively undisturbed flora than that of the glaciated area northwest of the park. Because of this phenomenon the flora of central Ross County is likely to be richer than the surrounding areas, assuming that the abiotic environment is fairly constant. However, human disturbances have had major influences on the park's vegetation.

The five units of Hopewell Culture park are High Banks, Hopewell, Hopeton, Mound City, and Seip (Figure 1). In 1995, the designated acreage was 1,134, of which 404 is federal land and the remainder non-federal. The separate units are all located in Ross County with the greatest distance between any two units being approximately 25 miles. Each of the five units is slightly different, and all are described in detail elsewhere (Bennett and Course 1996).

The area occupied by the park has a long history of modern human disturbance. The first park unit, Mound City Group, was originally a military base (the War Department's Camp Sherman) before being transferred to the National Park Service in 1923 by presidential proclamation as a national monument. Barracks and training facilities were removed to restore the mounds. Most of the Hopewell Mound Group unit's land has been farmed at one time and continues to be farmed today. As a historical park, Hopewell Culture's priority has been to protect Hopewell archeological resources. The park's long term objectives include restoring park land to the historic landscape. However, lack of research and funds have impeded that work. In many areas, maintaining hayfields has been the least costly and the least damaging man-

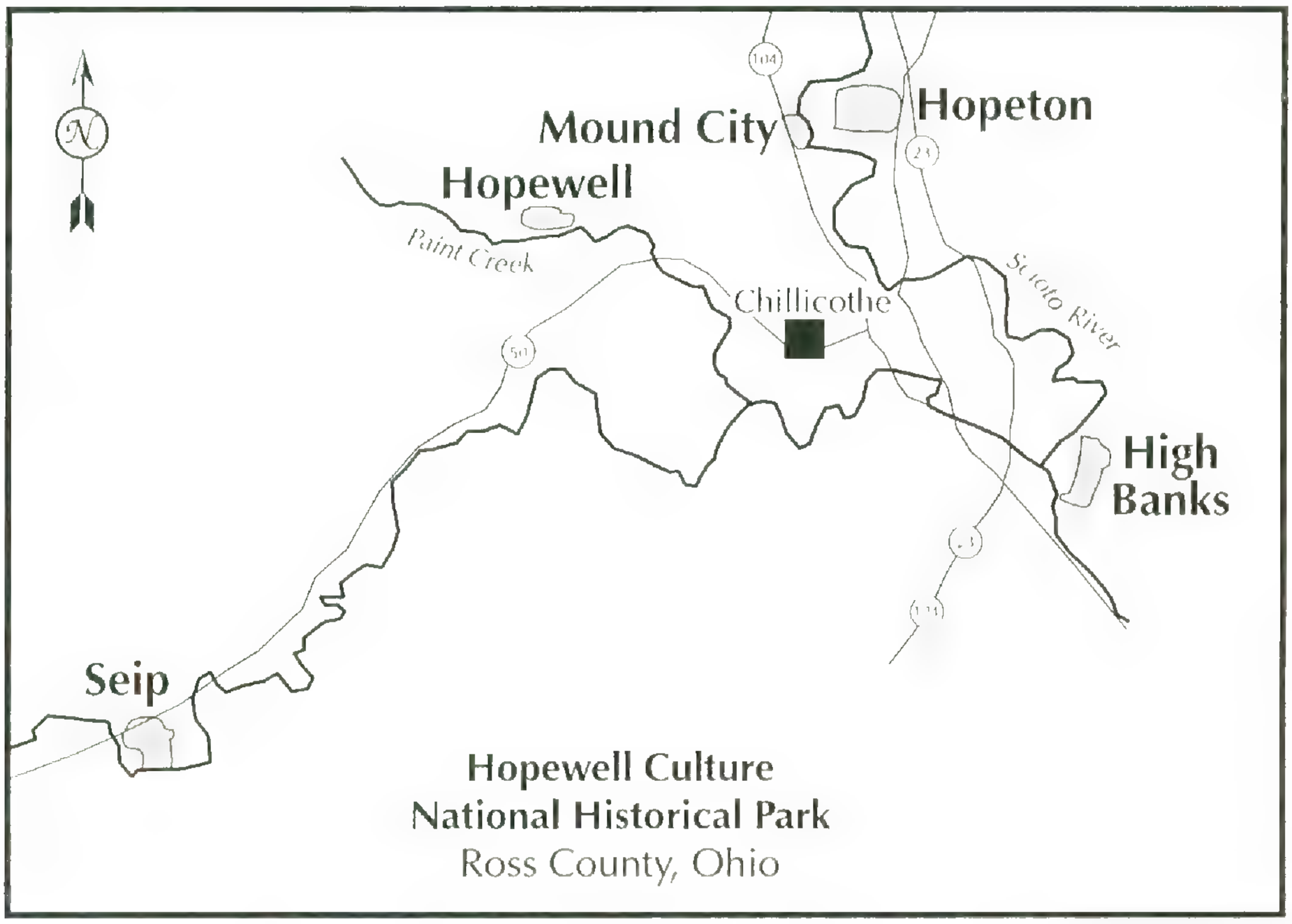

Figure 1. Map of Hopewell Culture National Historical Park (1 cm = approximately 3.5 miles).

agement of the earthworks. Consequently, a large percentage of the park is managed for this habitat.

MATERIALS AND METHODS

The taxonomic scope of this survey included all terrestrial and aquatic vascular plants. The field season ran from 15 March 1995 to 13 October 1995. The objective was to collect at least one specimen with reproductive parts of every naturally established plant species occurring within existing and/or proposed park boundaries. The following information was recorded with each specimen: locality, habitat, elevation, and collection date.

Standards for writing floras suggested by Palmer et al. (1995) were adhered to as much as possible for this study. Relative abundance was determined for each species collected, using a three-level abundance scale modified from Palmer et al.'s five rank scale:

Common	Dominant or co-dominant in one or more common habitats, or easily seen or found in one or more common habitats but not dominant in any common habitat.
Intermediate	Widely scattered but not difficult to find.
Rare	Difficult to find with few individuals or colonies but found in several locations, or very difficult to find and limited to one or very few locations or uncommon habitats.

In addition, species presence at other units of the park was noted periodically in order to determine frequency throughout the park. Lastly, the origin (native or introduced) of each species was recorded as determined by Gleason and Cronquist (1991).

Because it was uncertain how much land the park ultimately will purchase from the unacquired Hopewell, Seip, and High Banks units, some acreage was surveyed outside the currently proposed park unit boundaries. However, in some units, land was excluded from the survey because it was still under agriculture. The total acreage surveyed at each site was as follows: High Banks, 8; Hopewell, 247; Hopeton, 155; Mound City, 120; and Seip, 53. The grand total area surveyed was 583 acres. Acreages were estimated from park property maps.

Out of the approximate seven month field season, there were 82 field collecting days, with the majority of them occurring June through September. Size and habitat complexity were primary factors in determining frequency and length of visits to the five different units. The total number of collecting visits to each park unit was the following: High Banks, 7; Hopewell, 34; Hopeton, 29; Mound City, 41; and Seip, 13.

Specimens were identified using the following references: Braun (1967, 1989), Britton and Brown (1970), Catling (1983), Cobb (1963), Cooperrider (1995), Courtenay and Zimmerman (1978), Fisher (1988), Gleason and Cronquist (1991), Hitchcock (1935), Newcomb (1977), Petrides (1972), and Weishaupt (1971). The nomenclature followed for specimen and museum record labels is that of Gleason and Cronquist (1991).

New species for Ross County were determined from the county dot maps in Braun (1967), Cooperrider (1995), Fisher (1988), unpublished maps of J. Furlow, and the county presence data in Cusick and Silberhorn (1977).

RESULTS

Six hundred and eighty-six specimens representing 438 species were collected for this study (Table 1). Collection numbers for each species are available in Bennett and Course (1996). The voucher specimens were deposited in the park's museum collection at park headquarters and duplicates were deposited at the Ohio State University Herbarium in Columbus (OS). Ten specimens were unidentified.

A floristic summary for the park is shown in Table 2. Almost 80% of the species are dicots. The Hopewell unit had the greatest number of species (348). This was followed by the Mound City unit (268), Hopeton (238), Seip (219), and High Banks (175). These numbers roughly correspond with the acreages of the units. None of the species collected were new to the state of Ohio.

Two species were collected that are on the 1994-95 Ohio Division of Natural Areas and Preserves (1994) Rare Native Ohio Plant List:

Eleocharis ovata (Roth) Roemer & Schultes is listed as a state endangered species. Two specimens (JC0147 and JC0385) were found at Hopewell unit along the old logging road in a recently logged area approximately 300 meters east of the northwestern entrance of the forest. They were found in saturated soil near other species of the Cyperaceae. It should be noted that we are using the broad definition of this species according to Gleason and Cronquist (1991), which includes *Eleocharis obtusa* (Willd.) Schultes. Allison Cusick (pers. comm.) considers the specimen to be the latter and quite common throughout the state. *Eleocharis ovata* sensu stricto is quite rare and is found only in the northern part of the state.

Spiranthes ovalis Lindl. var. *erostellata* Catling is listed as a potentially threatened species in the state. It was listed formerly as a threatened species but recent findings indicate it may be more frequent in southern Ohio than previously thought (Catling 1983). One specimen (JC0633) was found 20 feet east of the service road in the Mound City unit in an open area of a moist, early successional woods.

Two species in the flora are represented by sight records: *Asparagus officinalis* and *Monotropa uniflora*. *Toxicodendron rad-*

Table 1. Vascular plant species of Hopewell Culture National Historical Park. The list of taxa is sorted first by major group, then alphabetically by family, genus and species. For each species, relative abundance on a three point scale (C = common, I = intermediate, R = rare) and the units of the park the species occurs in (HB = High Banks, HL = Hopewell, HN = Hopeton, MC = Mound City, and SP = Seip) are given. Species preceded by a [1] are new records for Ross County, and those by a [2] are not native.

Taxon	Abundance	Park Units
Pteridophytes		
ADIANTACEAE		
Adiantum pedatum L.	R	HL
ASPLENIACEAE		
Asplenium platyneuron (L.) Oakes	I	HL, MC, SP
Polystichum acrostichoides (Michx.) Schott	R	HL
EQUISETACEAE		
Equisetum arvense L.	R	HL
ONOCLEACEAE		
Onoclea sensibilis L.	R	HL
OPHIOGLOSSACEAE		
Botrychium dissectum Spreng.	R	HL
Botrychium virginianum (L.) Swartz	I	HL, MC
Gymnosperms		
CUPRESSACEAE		
Juniperus virginiana L.	R	HN, MC
Angiosperms		
ACANTHACEAE		
Justicia americana (L.) M. Vahl	R	HB, MC, SP
Ruellia strepens L.	I	HN, HL, MC, SP
ACERACEAE		
Acer negundo L.	C	HB, HN, HL, MC, SP
Acer saccharinum L.	C	HB, HN, HL, MC, SP
Acer saccharum Marshall	C	HB, HN, HL, MC, SP
ALISMATACEAE		
Sagittaria latifolia Willd.	R	MC
AMARANTHACEAE		
[2]*Amaranthus retroflexus* L.	I	HB, HN, HL
Amaranthus tuberculatus (Moq.) Sauer	R	MC
ANACARDIACEAE		
Rhus glabra L.	I	MC, SP
Rhus typhina L.	I	HN, HL, MC, SP
Toxicodendron radicans (L.) Kuntze	C	HB, HN, HL, MC, SP
ANNONACEAE		
Asimina triloba (L.) Dunal	I	HB, HL, MC, SP

Table 1. Continued.

Taxon	Abundance	Park Units
APIACEAE		
Chaerophyllum procumbens (L.) Crantz	I	HL
[2]*Conium maculatum* L.	C	HB, HN, HL, MC, SP
Cryptotaenia canadensis (L.) DC.	C	HB, HN, HL, MC, SP
[2]*Daucus carota* L.	C	HB, HN, HL, MC, SP
Erigenia bulbosa (Michx.) Nutt.	I	HL
Osmorhiza clatyonii (Michx.) C.B. Clarke	I	HL
[1]*Osmorhiza longistylis* (Torr.) DC.	C	HB, HN, HL, MC, SP
[2]*Pastinaca sativa* L.	C	HB, HN, HL, MC, SP
Sanicula gregaria E. Bickn.	C	HB, HN, HL, MC, SP
[2]*Torilis arvensis* (Hudson) Link	I	HB, HN, HL, MC, SP
APOCYNACEAE		
Apocynum cannabinum L.	C	HB, HN, HL, MC, SP
[1,2]*Vinca minor* L.	I	MC
ARACEAE		
Arisaema triphyllum (L.) Schott	R	HL, MC
ARALIACEAE		
Panax quinquefolius L.	R	HL
ARISTOLOCHIACEAE		
Asarum canadense L.	I	HL, MC, SP
ASCLEPIADACEAE		
Ampelamus albidus (Nutt.) Britton	I	HB, HN, HL, MC, SP
Asclepias incarnata L.	R	HL
Asclepias syriaca L.	C	HB, HN, HL, MC, SP
Asclepias tuberosa L.	R	HN, SP
ASTERACEAE		
[2]*Achillea millefolium* L.	I	HB, HN, HL, MC, SP
[2]*Ambrosia artemisiifolia* L.	C	HB, HN, HL, MC, SP
Ambrosia trifida L.	C	HB, HN, HL, MC, SP
[2]*Arctium minus* Schk.	I	HB, HN, HL, MC, SP
[2]*Artemisia annua* L.	R	MC
[2]*Artemisia vulgaris* L.	R	MC
Aster cordifolius L.	I	HN, HL, MC, SP
Aster lanceolatus Willd.	I	HL
Aster lateriflorus (L.) Britton	I	HL
Aster novae-angliae L.	I	HN, HL, MC, SP
Aster pilosus Willd.	C	HB, HN, HL, MC, SP
Aster sagittifolius Willd.	R	HL
Aster shortii Lindley	I	HB, HN, HL, MC, SP
Bidens bipinnata L.	R	HL, MC
Bidens cernua L.	R	HL
Bidens frondosa L.	I	HL, SP
Bidens vulgata Greene	I	HL

Table 1. Continued.

Taxon	Abundance	Park Units
[2]*Cacalia atriplicifolia* L.	R	SP
[1,2]*Carduus nutans* L.	R	HN
[2]*Chrysanthemum leucanthemum* L.	C	HB, HN, HL, MC, SP
[2]*Cichorium intybus* L.	C	HB, HN, HL, MC, SP
[2]*Cirsium arvense* (L.) Scop.	C	HB, HN, HL, MC, SP
[2]*Cirsium vulgare* (Savi) Tenore	C	HB, HN, HL, MC, SP
Conyza canadensis (L.) Cronq.	C	HB, HN, HL, MC, SP
Echinacea purpurea (L.) Moench	R	MC
Erechtites hieraciifolia (L.) Raf.	I	HL
Erigeron annuus (L.) Pers.	C	HB, HN, HL, MC, SP
Erigeron philadelphicus L.	C	HB, HN, HL, MC, SP
Eupatorium altissimum L.	R	HN
Eupatorium coelestinum L.	I	HL, MC, SP
Eupatorium perfoliatum L.	I	HL
Eupatorium purpureum L.	R	HL
Eupatorium rugosum Houttuyn	C	HB, HN, HL, MC, SP
[1]*Eupatorium serotinum* Michx.	R	HL
Euthamia graminifolia (L.) Nutt.	I	HB, HL, MC
[1]*Gnaphalium obtusifolium* L.	I	HB, HN, HL, MC, SP
Helianthus tuberosus L.	C	HB, HN, HL, MC, SP
Heliopsis helianthoides (L.) Sweet	I	HL, SP
[1,2]*Hieracium caespitosum* Dumort.	I	MC
Kuhnia eupatorioides L.	I	HN, HL
[1]*Lactuca canadensis* L.	C	HN, HL
Lactuca floridana (L.) Gaertner	C	HN, HL, MC, SP
[2]*Lactuca serriola* L.	C	HB, HN, HL, MC, SP
[1,2]*Matricaria maritima* L.	R	HN
[2]*Matricaria matricarioides* (Less.) Porter	R	MC
Polymnia canadensis L.	C	HL, MC, SP
Ratibida pinnata (Vent.) Barnhart	R	SP
Rudbeckia fulgida Aiton	I	HN, HL
Rudbeckia hirta L.	R	HL, MC, SP
Rudbeckia triloba L.	I	HB, HN, HL, MC
Senecio aureus L.	I	MC
[2]*Senecio obovatus* Muhl.	R	HN, HL, MC
Silphium perfoliatum L.	I	HN
Solidago canadensis L.	C	HB, HN, HL, MC, SP
Solidago flexicaulis L.	R	HL, SP
Solidago gigantea Aiton	I	HB, HN, HL, MC, SP
Solidago juncea Aiton	I	HN
Solidago rugosa Miller	I	HB, HN, HL, MC, SP
[2]*Sonchus asper* (L.) Hill	I	HB, HN, HL, MC, SP
Taraxacum officinale Weber ex Wiggers	C	HB, HN, HL, MC, SP
[2]*Tragopogon pratensis* L.	I	HB, HN, HL, MC, SP
Verbesina alternifolia (L.) Britton	C	HB, HN, HL, MC, SP

Table 1. Continued.

Taxon	Abundance	Park Units
Vernonia gigantea (Walter) Trel.	C	HB, HN, HL, MC, SP
Xanthium strumarium L.	I	HL, MC, SP
BALSAMINACEAE		
[2]*Impatiens capensis* Meerb.	C	HB, HN, HL, MC, SP
Impatiens pallida Nutt.	C	HB, HN, HL, MC, SP
BERBERIDACEAE		
[2]*Jeffersonia diphylla* (L.) Pers.	I	HL
Podophyllum peltatum L.	I	HL, MC
BETULACEAE		
Carpinus caroliniana Walter	R	SP
Ostrya virginiana (Miller) K. Koch	I	HL, MC, SP
BIGNONIACEAE		
Campsis radicans (L.) Seemann	C	HB, HN, HL, MC, SP
[2]*Catalpa speciosa* Warder	R	HN
BORAGINACEAE		
[2]*Echium vulgare* L.	R	HB
Hackelia virginiana (L.) I. M. Johnston	I	HL, MC
[2]*Lithospermum arvense* L.	I	HN, MC
Mertensia virginica (L.) Pers.	I	HL, MC
BRASSICACEAE		
[2]*Alliaria petiolata* (Bieb.) Cavara & Grande	C	HB, HN, HL, MC, SP
[2]*Arabidopsis thaliana* (L.) Heynh.	I	HN
Arabis perstellata L. Braun	I	SP
[2]*Barbarea vulgaris* R. Br.	C	HB, HN, HL, MC, SP
[1,2]*Berteroa incana* (L.) DC.	R	HB
[2]*Brassica nigra* L.	I	MC
[2]*Capsella bursa-pastoris* (L.) Medikus	C	HB, HN, HL, MC, SP
[1]*Cardamine douglassii* Britton	I	HL
Cardamine parviflora L.	I	HN, HL
[2]*Draba verna* L.	C	HB, HN, HL, MC, SP
[2]*Erysimum repandum* L.	I	HN, HL
[1,2]*Hesperis matronalis* L.	I	HN
Iodanthus pinnatifidus (Michx.) Steudel	I	HL, MC, SP
[2]*Lepidium campestre* (L.) R. Br.	C	HB, HN, HL, MC, SP
Lepidium virginicum L.	I	HB, HN, HL, MC, SP
[2]*Rorippa nasturtium-aquaticum* (L.) Hayek	R	HB, HN, HL
[2]*Sisymbrium officinale* (L.) Scop.	I	HB, HN
[2]*Thlaspi arvense* L.	C	HB, HN, HL, MC, SP
[2]*Thlaspi perfoliatum* L.	C	HB, HN, HL, MC, SP
CAESALPINIACEAE		
Cercis canadensis L.	C	HB, HN, HL, MC, SP
Gleditsia triacanthos L.	I	HB, HN, HL, MC, SP
Gymnocladus dioica (L.) K. Koch	R	HN, HL, MC

Table 1. Continued.

Taxon	Abundance	Park Units
CAMPANULACEAE		
Campanula americana L.	I	HN, HL, MC, SP
Lobelia inflata L.	I	HB, HN, HL, MC
Lobelia siphilitica L.	I	HN, HL, SP
Triodanis perfoliata (L.) Nieuwl.	I	HB, HN, HL, MC, SP
CANNABACEAE		
[2]*Humulus lupulus* L.	I	HL, MC
CAPRIFOLIACEAE		
[2]*Lonicera japonica* Thunb.	C	HB, HN, HL, MC, SP
[1,2]*Lonicera maackii* (Rupr.) Maxim.	C	HB, HN, HL, MC, SP
[1,2]*Lonicera tatarica* L.	C	MC
Sambucus canadensis L.	I	HN, HL
Symphoricarpos orbiculatus Moench	I	HL, MC
CARYOPHYLLACEAE		
[2]*Cerastium vulgatum* L.	I	HN, MC
[2]*Dianthus armeria* L.	I	HB, HN, HL, MC, SP
[2]*Saponaria officinalis* L.	C	HB, HN, HL, MC, SP
Silene antirrhina L.	I	HL
[1,2]*Silene latifolia* Poiret	C	HB, HN, HL, MC, SP
[2]*Silene noctiflora* L.	R	SP
Silene stellata (L.) Aiton f.	R	HL, MC
Silene virginica L.	R	HL
[2]*Silene vulgaris* (Moench) Garcke	C	HB, HN, HL, MC, SP
[2]*Stellaria media* (L.) Villars	C	HB, HN, HL, MC, SP
CELASTRACEAE		
Celastrus scandens L.	C	HN, HL, MC, SP
[1,2]*Euonymus alatus* (Thunb.) Siebold	R	MC
Euonymus atropurpureus Jacq.	I	HB, HN, HL, MC, SP
CHENOPODIACEAE		
[2]*Chenopodium album* L.	C	HB, HN, HL, MC, SP
CLUSIACEAE		
Hypericum mutilum L.	R	HL
[2]*Hypericum perforatum* L.	I	HB, HN, HL, MC
Hypericum punctatum Lam.	I	HL
COMMELINACEAE		
[2]*Commelina communis* L.	I	HB, HN, HL, SP
CONVOLVULACEAE		
[2]*Calystegia sepium* (L.) R. Br.	C	HB, HN, HL, MC, SP
[2]*Convolvulus arvensis* L.	I	HB, HL, MC
[2]*Ipomoea hederacea* Jacq.	I	HB, HN, HL, MC, SP
Ipomoea lacunosa L.	I	HB, HN
Ipomoea pandurata (L.) G. Meyer	C	HB, HN, HL, MC, SP

Table 1. Continued.

Taxon	Abundance	Park Units
CORNACEAE		
Cornus drummondii C. A. Meyer	R	HB, HN, MC
Cornus florida L.	I	HB, HN, HL, MC, SP
CUCURBITACEAE		
[1]*Cucurbita pepo* L.	R	HN
Sicyos angulatus L.	R	MC
CYPERACEAE		
[1]*Carex albicans* Willd.	I	HL
Carex albursina Sheldon	R	HL
[1]*Carex amphibola* Steudel	R	HL, MC
[1]*Carex blanda* Dewey	R	HL
[1]*Carex careyana* Torr.	R	HL
Carex davisii Schwein. & Torr.	R	HL
Carex festucacea Schk.	R	HL
[1]*Carex flaccosperma* Dewey	R	HL
[1]*Carex gracillima* Schwein.	R	HL
Carex hirtifolia Mackenzie	R	HL
Carex jamesii Schwein.	R	HL
[1]*Carex laxiculmis* Schwein.	R	HL
[1]*Carex retroflexa* Muhl.	R	SP
Carex rosea Schk.	R	HL
[1]*Carex shortiana* Dewey	R	HL
[1]*Carex squarrosa* L.	I	HN, HL
Carex stipata Muhl.	I	HN, HL
[1]*Carex vulpinoidea* Michx.	R	HL
Cyperus esculentus L.	I	HL
Eleocharis ovata (Roth) Roemer & Schultes	R	HL
Scirpus atrovirens Willd.	I	HL
Scirpus lineatus Michx.	R	HL
DIPSACACEAE		
[2]*Dipsacus sylvestris* Hudson	C	HB, HN, HL, MC, SP
ELAEAGNACEAE		
[1,2]*Elaeagnus angustifolia* L.	R	HN, HL
EUPHORBIACEAE		
Acalypha rhomboidea Raf.	I	HN, HL, MC
Acalypha virginica L.	R	HL
Euphorbia commutata Engelm.	R	HL
Euphorbia dentata Michx.	R	MC
Euphorbia maculata L.	C	HB, HN, HL, MC, SP
FABACEAE		
Amphicarpaea bracteata (L.) Fern.	R	HL, SP
Desmodium canescens (L.) DC.	I	HN, HL, MC, SP

Table 1. Continued.

Taxon	Abundance	Park Units
[1]*Desmodium nudiflorum* (L.) DC.	R	HL
[2]*Medicago lupulina* L.	C	HB, HN, HL, MC, SP
[2]*Medicago sativa* L.	C	HB, HN, HL, MC, SP
[2]*Melilotus alba* Medikus	C	HB, HN, HL, MC, SP
[2]*Melilotus officinalis* (L.) Pallas	C	HB, HN, HL, MC, SP
Robinia pseudoacacia L.	C	HB, HN, HL, MC, SP
[2]*Trifolium campestre* Schreb.	C	HB, HN, HL, MC, SP
[2]*Trifolium hybridum* L.	C	HB, HN, HL, MC, SP
[2]*Trifolium incarnatum* L.	R	HN
[2]*Trifolium pratense* L.	C	HB, HN, HL, MC, SP
[2]*Vicia cracca* L.	I	HN
FAGACEAE		
Fagus grandifolia Ehrh.	R	HL
Quercus alba L.	I	HN, HL, MC
Quercus bicolor Willd.	I	HL, MC
Quercus imbricaria Michx.	R	HL, MC
[2]*Quercus macrocarpa* Michx.	R	HL, MC, SP
Quercus muehlenbergii Engelm.	I	HL, SP
Quercus rubra L.	I	HB, HN, HL, MC, SP
FUMARIACEAE		
Corydalis flavula (Raf.) DC.	I	MC
Dicentra cucullaria (L.) Bernh.	R	HL, MC
GERANIACEAE		
Geranium carolinianum L.	C	HB, HN, HL, MC, SP
Geranium maculatum L.	I	HL, MC
HAMAMELIDACEAE		
Hamamelis virginiana L.	R	MC
[1]*Liquidambar styraciflua* L.	I	HN, HL, MC, SP
HIPPOCASTANACEAE		
Aesculus glabra Willd.	I	HB, HL, MC, SP
HYDROPHYLLACEAE		
Hydrophyllum appendiculatum Michx.	I	HL
[2]*Phacelia purshii* Buckley	I	HN, HL
IRIDACEAE		
Sisyrinchium angustifolium Miller	I	HL
JUGLANDACEAE		
Carya cordiformis (Wangenh.) K. Koch	R	HL
Carya ovata (Miller) K. Koch	I	HN, HL
Juglans nigra L.	C	HB, HN, HL, MC, SP
JUNCACEAE		
[2]*Juncus tenuis* Willd.	R	HN, HL
Juncus torreyi Cov.	R	HL
Luzula multiflora (Retz.) Lej.	I	HL

Table 1. Continued.

Taxon	Abundance	Park Units
LAMIACEAE		
[2]*Agastache nepetoides* (L.) Kuntze	R	HL
Blephilia hirsuta (Pursh) Benth.	I	HL
[2]*Glechoma hederacea* L.	C	HB, HN, HL, MC, SP
Hedeoma pulegioides (L.) Pers.	R	HL
[1]*Lamium album* L.	R	MC
[2]*Lamium amplexicaule* L.	I	HN, MC
[2]*Lamium purpureum* L.	C	HB, HN, HL, MC, SP
[2]*Leonurus cardiaca* L.	I	HB, HN, HL, MC, SP
Lycopus americanus Muhl.	R	HL
Monarda fistulosa L.	I	HN, MC
[2]*Nepeta cataria* L.	R	HB, SP
Prunella vulgaris L.	I	HB, HN, HL, MC, SP
Teucrium canadense L.	C	HB, HN, HL, MC
LAURACEAE		
Sassafras albidum (Nutt.) Nees	I	HN, HL, MC, SP
LENTIBULARIACEAE		
[1]*Utricularia gibba* L.	R	HL
LILIACEAE		
[1]*Allium cernuum* Roth	C	HB, HN, HL, MC, SP
[1]*Allium tricoccum* Aiton	R	HL, SP
[1,2]*Allium vineale* L.	C	HB, HN, HL, MC, SP
[2]*Asparagus officinalis* L.	I	HN, MC
Camassia scilloides (Raf.) Cory	R	HL, SP
[1]*Erythronium albidum* Nutt.	I	HL
[1,2]*Hemerocallis fulva* (L.) L.	I	HN, HL, SP
[1]*Lilium canadense* L.	R	SP
[1,2]*Ornithogalum umbellatum* L.	C	HB, HN, HL, MC, SP
Polygonatum biflorum (Walter) Elliott	R	HN, HL, MC
Smilacina racemosa (L.) Desf.	I	HL, MC, SP
Trillium sessile L.	I	HL
Uvularia grandiflora J. E. Smith	R	MC
MAGNOLIACEAE		
Liriodendron tulipifera L.	I	MC, SP
MALVACEAE		
[2]*Abutilon theophrasti* Medikus	R	HN, MC
[1,2]*Hibiscus trionum* L.	R	SP
[1,2]*Malva rotundifolia* L.	C	HB, HN, HL, MC, SP
[2]*Sida spinosa* L.	I	HB, HN, HL, MC
MENISPERMACEAE		
Menispermum canadense L.	C	HB, HN, HL, MC, SP
MONOTROPACEAE		
Monotropa uniflora L.	R	HL

Table 1. Continued.

Taxon	Abundance	Park Units
MORACEAE		
[2]*Maclura pomifera* (Raf.) Schneid.	R	HN, MC
[2]*Morus alba* L.	C	HB, HN, HL, MC, SP
Morus rubra L.	I	HB, HN, HL, MC, SP
NYCTAGINACEAE		
Mirabilis nyctaginea (Michx.) MacMillan	I	HN, MC
OLEACEAE		
Fraxinus americana L.	C	HB, HN, HL, MC, SP
Fraxinus pennsylvanica Marshall	C	HB, HN, HL, MC, SP
Fraxinus quadrangulata Michx.	R	HL
[1,2]*Ligustrum vulgare* L.	R	MC
ONAGRACEAE		
Circaea lutetiana L.	I	HL
[1]*Epilobium glandulosum* Lehm.	R	HL
Gaura biennis L.	I	HN, MC
Oenothera biennis L.	I	HN, HL, MC
Oenothera perennis L.	R	HN, HL
ORCHIDACEAE		
[1]*Aplectrum hyemale* (Muhl.) Torr.	R	HL
[1]*Spiranthes ovalis* Lindl.	R	MC
OXALIDACEAE		
Oxalis stricta L.	C	HB, HN, HL, MC, SP
Oxalis violacea L.	R	HL
PAPAVERACEAE		
[2]*Papaver dubium* L.	R	HN
[2]*Sanguinaria canadensis* L.	I	HL
PHYTOLACCACEAE		
Phytolacca americana L.	C	HB, HN, HL, MC, SP
PLANTAGINACEAE		
[2]*Plantago lanceolata* L.	C	HB, HN, HL, MC, SP
[1,2]*Plantago major* L.	C	HB, HN, HL, MC, SP
PLATANACEAE		
[2]*Platanus occidentalis* L.	I	HB, HN, HL, MC, SP
POACEAE		
[1]*Agrostis hyemalis* (Walter) BSP.	R	SP
Andropogon gerardii Vitman	I	SP
[2]*Bromus commutatus* Schrader	I	HB, HN, HL, MC, SP
[1,2]*Bromus inermis* Leysser	C	MC
[2]*Bromus tectorum* L.	I	HN, MC
Chasmanthium latifolium (Michx.) Yates	R	SP
[1]*Cinna arundinacea* L.	I	HB, HN, HL, MC, SP
[2]*Dactylis glomerata* L.	C	HB, HN, HL, MC, SP
[2]*Digitaria sanguinalis* (L.) Scop.	I	HB, HN, HL, MC, SP

Table 1. Continued.

Taxon	Abundance	Park Units
[2]*Echinochloa crusgalli* (L.) P. Beauv.	C	HB, HN, HL, MC, SP
[2]*Eleusine indica* (L.) Gaertn.	I	HB, HN, HL, MC, SP
[1]*Elymus canadensis* L.	C	HB, HN, HL, MC, SP
Elymus hystrix L.	I	HB, HN, HL, MC, SP
Elymus villosus Muhl.	I	HN, HL
[1,2]*Elytrigia repens* (L.) Nevski	C	HB, HN, HL, MC, SP
[1]*Eragrostis capillaris* (L.) Nees	I	HL
[1,2]*Festuca elatior* L.	C	HB, HN, HL, MC, SP
[1,2]*Festuca ovina* L.	R	SP
[1]*Festuca subverticillata* (Pers.) E. Alexeev	I	HN, HL, MC, SP
Glyceria striata (Lam.) A. Hitchc.	R	HL
Leersia virginica Willd.	I	HL, MC
[2]*Muhlenbergia schreberi* J. F. Gmelin	I	HN, HL, MC, SP
Panicum capillare L.	I	HB, HN, HL, MC, SP
Panicum dichotomiflorum Michx.	I	HB, HL
Panicum lanuginosum Elliott	I	HB, HN, HL, MC, SP
[1]*Panicum latifolium* L.	I	HL, SP
Panicum virgatum L.	I	HN, HL, SP
[2]*Phleum pratense* L.	C	HB, HN, HL, MC, SP
[2]*Poa pratensis* L.	I	HB, HN, HL, MC, SP
Poa sylvestris A. Gray	I	MC
[1,2]*Setaria faberi* R. Herrm.	I	HN, HL, MC, SP
[2]*Setaria glauca* (L.) P. Beauv.	C	HB, HN, HL, MC, SP
[1,2]*Setaria italica* (L.) P. Beauv.	I	HL
[2]*Setaria viridis* (L.) P. Beauv.	C	HB, HN, HL, MC, SP
Sorghastrum nutans (L.) Nash	I	HL, SP
[2]*Sorghum halepense* (L.) Pers.	C	HB, HN, HL, MC, SP
Tridens flavus (L.) A. Hitchc.	C	HB, HN, HL, MC, SP
POLEMONIACEAE		
Phlox divaricata L.	I	HL
Phlox paniculata L.	I	MC, SP
Polemonium reptans L.	I	HL
POLYGONACEAE		
[2]*Polygonum aviculare* L.	C	HB, HN, HL, MC, SP
Polygonum cespitosum Blume	I	HL
Polygonum pensylvanicum L.	I	HB, HN, HL, MC, SP
[2]*Polygonum persicaria* L.	C	HN, HL, MC
Polygonum punctatum Elliott	I	MC
[2]*Polygonum scandens* L.	I	HB, HN, HL
Polygonum virginianum L.	I	HL, MC
[2]*Rumex acetosella* L.	I	HB, SP
[2]*Rumex crispus* L.	C	HB, HN, HL, MC, SP
[2]*Rumex obtusifolius* L.	I	HN, HL
Rumex verticillatus L.	I	MC

Table 1. Continued.

Taxon	Abundance	Park Units
PORTULACACEAE		
Claytonia virginica L.	C	HB, HN, HL, MC, SP
POTAMOGETONACEAE		
Potamogeton nodosus Poir.	R	HL
PRIMULACEAE		
Lysimachia ciliata L.	R	MC
[2]*Lysimachia nummularia* L.	C	HB, HN, HL, MC, SP
Samolus floribundus HBK.	R	HL
RANUNCULACEAE		
Actaea alba (L.) Miller	R	HL
Anemone virginiana L.	I	HL, MC, SP
Anemonella thalictroides (L.) Spach	I	HL, MC
Aquilegia canadensis L.	R	HL, MC
Clematis viorna L.	R	HL
Clematis virginiana L.	I	HN, HL
Delphinium tricorne Michx.	I	HL
Hydrastis canadensis L.	R	HL
Ranunculus abortivus L.	C	HB, HN, HL, MC, SP
Ranunculus hispidus Michx.	I	HL
[2]*Ranunculus micranthus* Nutt.	R	HL
Thalictrum revolutum DC.	R	SP
ROSACEAE		
Agrimonia gryposepala Wallr.	I	HL, SP
Agrimonia parviflora Aiton	R	HL, SP
Crataegus coccinea L.	I	HB, MC, SP
Crataegus crus-galli L.	R	MC
Crataegus punctata Jacq.	R	HL
[2]*Duchesnea indica* (Andrews) Focke	I	HL, MC
Fragaria virginiana Duchesne	I	HL
Geum canadense Jacq.	C	HB, HN, HL, MC, SP
Geum vernum (Raf.) T. & G.	I	HL
Physocarpus opulifolius (L.) Maxim.	R	SP
[2]*Potentilla norvegica* L.	I	HB, HN
[2]*Potentilla recta* L.	I	HB, HN, HL, MC, SP
[1,2]*Prunus mahaleb* L.	R	MC
Prunus serotina Ehrh.	I	HB, HL, MC
Pyrus malus L.	R	HL
[1,2]*Rhodotypos scandens* (Thunb.) Makino	R	MC
[2]*Rosa multiflora* Thunb.	C	HB, HN, HL, MC, SP
Rosa setigera Michx.	R	HN, HL
Rubus allegheniensis T. C. Porter	I	HB, HN, HL, MC, SP
Rubus occidentalis L.	C	HB, HN, HL, MC, SP
[1]*Rubus pensilvanicus* Poiret	I	HB, HN, HL, MC, SP

Table 1. Continued.

Taxon	Abundance	Park Units
RUBIACEAE		
Galium aparine L.	C	HB, HN, HL, MC, SP
Galium circaezans Michx.	I	HL, SP
Galium concinnum T. & G.	I	HL
[2]*Galium mollugo* L.	I	HL
RUTACEAE		
Ptelea trifoliata L.	R	HL, MC, SP
SALICACEAE		
Populus deltoides Marshall	I	HB, HN, HL, MC, SP
Salix nigra Marshall	C	HB, HN, HL, MC, SP
SAXIFRAGACEAE		
Penthorum sedoides L.	R	HL
SCROPHULARIACEAE		
Dasistoma macrophylla (Nutt.) Raf.	R	HL
[1]*Mimulus alatus* Aiton	I	HL
Penstemon digitalis Nutt.	I	HN, HL
Penstemon hirsutus (L.) Willd.	I	HN, HL, MC
Scrophularia marilandica L.	R	SP
[2]*Verbascum blattaria* L.	I	HN, HL, MC
[2]*Verbascum thapsus* L.	C	HB, HN, HL, MC, SP
[2]*Veronica arvensis* L.	C	HB, HN, HL, MC, SP
[2]*Veronica officinalis* L.	C	HB, HN, HL, MC, SP
[2]*Veronica persica* Poir.	C	HB, HN, HL, MC, SP
Veronica serpyllifolia L.	I	HB, HN, HL, MC, SP
SIMAROUBACEAE		
[2]*Ailanthus altissima* (Miller) Swingle	I	HN, MC, SP
SMILACACEAE		
[1]*Smilax ecirrhata* (Engelm.) S. Wats.	I	HB, HN, HL, MC, SP
Smilax rotundifolia L.	I	HB, HN, HL, MC, SP
SOLANACEAE		
Datura stramonium L.	I	HN, HL
[1,2]*Petunia* × *hybrida* Vilm.	R	MC
Physalis heterophylla Nees	C	HB, HN, HL, MC, SP
Physalis longifolia Nutt.	R	HL
[2]*Solanum carolinense* L.	C	HB, HN, HL, MC, SP
Solanum nigrum L.	I	HL, MC
TILIACEAE		
Tilia americana L.	I	HB, HL, MC, SP
TYPHACEAE		
Typha latifolia L.	I	HL
ULMACEAE		
Celtis occidentalis L.	C	HB, HN, HL, MC, SP
Ulmus americana L.	R	HN

Table 1. Continued.

Taxon	Abundance	Park Units
[1,2]*Ulmus pumila* L.	I	HN, MC
Ulmus rubra Muhl.	C	HB, HN, HL, MC, SP
URTICACEAE		
Boehmeria cylindrica (L.) Swartz	I	HB, HN, HL, MC, SP
Laportea canadensis (L.) Wedd.	I	HB, HN, MC
Pilea pumila (L.) A. Gray	C	HB, HN, HL, MC, SP
Urtica dioica L.	I	HN, HL, MC
VALERIANACEAE		
Valerianella chenopodifolia (Pursh) DC.	I	HN, MC
[2]*Valerianella locusta* (L.) Betcke	I	MC
VERBENACEAE		
Phryma leptostachya L.	R	HL, MC, SP
Verbena hastata L.	R	HN
Verbena urticifolia L.	I	HB, HN, HL, MC, SP
VIOLACEAE		
Viola palmata L.	R	HL
Viola pubescens Aiton	I	HL
Viola rafinesquii Greene	I	HN, MC
Viola sororia Willd.	C	HB, HN, HL, MC, SP
Viola striata Aiton	I	HL, SP
VITACEAE		
Parthenocissus quinquefolia (L.) Planchon	C	HB, HN, HL, MC, SP
[2]*Vitis aestivalis* Michx.	I	HN MC, SP
[1]*Vitis riparia* Michx.	C	HB, HN, HL, MC, SP
Vitis vulpina L.	I	HB, HN, HL, MC, SP

Table 2. Floristic summary of plant taxa of Hopewell Culture National Historical Park.

		Species		
Group	Families	Genera	Native	Introduced	Total
Pteridophytes	5	6	7	0	7
Gymnosperms	1	1	1	0	1
Angiosperms					
Dicots	75	225	228	116	344
Monocots	12	49	61	25	86
Total	93	281	297	141	438

icans was documented by a specimen collected by C. Roth in 1976, which was found in the park herbarium.

Three unpublished plant lists compiled by C. Roth, A. Shoemaker, and J. McMahon were found at the park and reviewed. Some species on these lists were not found during the 1995 field season, and may or may not occur in the park. These species were not included on the park list: *Allium canadense* L., *Allium stellatum* Ker Gawler, *Arabis hirsuta* (L.) Scop., *Brassica rapa* L., *Cardamine concatenata* (Michx.) O. Schwarz, *Carya tomentosa* (Poiret) Nutt., *Cirsium altissimum* (L.) Sprengel, *Eupatorium fistulosum* Barratt, *Geranium bicknellii* Britton, *Geranium pusillum* L., *Geum virginianum* L., *Matelea obliqua* (Jacq.) Woodson, *Paulownia tomentosa* (Thunb.) Steudel, *Potentilla simplex* Michx., *Rubus hispidus* L., *Rubus villosus* (presumably *Rubus flagellaris* Willd.), *Rudbeckia laciniata* L., *Saxifraga bronchialis* L., *Solanum rostratum* Dunal, *Stellaria graminea* L., *Trifolium aureum* Pollich, *Trifolium repens* L., *Verbena stricta* Vent., *Veronica filiformis* J. E. Smith, *Viola blanda* Willd., and *Zizia* sp.

The following species were determined to be planted and not reproducing and are, therefore, not included on the park list: *Acer rubrum* L., *Aesculus hippocastanum* L., *Albizia julibrissin* Durazz., *Berberis thunbergii* DC., *Broussonetia papyrifera* (L.) Vent., *Fraxinus excelsior* L., *Hibiscus syriacus* L., *Koelreuteria paniculata* Laxm., *Philadelphus inodorus* L., *Philadelphus pubescens* Loisel., *Picea abies* (L.) Karst., *Pinus nigra* Arnold, *Pinus resinosa* Aiton, *Pinus strobus* L., *Quercus coccinea* Muenchh., *Quercus palustris* Muenchh., *Syringa vulgaris* L., *Thuja occidentalis* L., *Triticum aestivum* L., and *Viburnum opulus* L.

Some specimens were identified to the variety level. These typically are excluded from floras because of their uncertain taxonomic status. The species, however, are included in the park list. They include *Acer negundo* var. *negundo, Aster lanceolatus* var. *simplex* (Willd.) A. G. Jones, *Aster pilosus* var. *pilosus, Cardamine parviflora* var. *arenicola* (Britt.) O. E. Schulz, *Carex albicans* var. *albicans, Cercis canadensis* var. *canadensis, Chaerophyllum procumbens* var. *shortii* T. & G., *Cirsium arvense* var. *horridum* Wimmer & Graebner, *Conyza canadensis* var. *canadensis, Erechtites hieraciifolia* var. *hieraciifolia, Eupatorium rugosum* var. *rugosum, Fraxinus americana* var. *americana, Fraxinus pennsylvanica* var. *subintegerrima* (Vahl) Fern., *Fraxinus pennsylvanica* var. *pennsylvanica, Heliopsis helianthoides* var. *scabra*

(Dunal) Fern., *Humulus lupulus* var. *pubescens* E. Small, *Physalis longifolia* var. *subglabrata* (Mackenzie & Bush) Cronq., *Polemonium reptans* var. *villosum* E. Braun, *Polygonum cespitosum* var. *longisetum* (De Bruyn) Stewart, *Polygonum scandens* var. *dumetorum* (L.) Gleason, *Prunella vulgaris* var. *lanceolata* (Barton) Fern., *Rudbeckia hirta* var. *pulcherrima* Farw., *Sagittaria latifolia* var. *latifolia, Solanum nigrum* var. *virginicum* L., *Solidago gigantea* var. *leiophylla* Fern., *Spiranthes ovalis* var. *erostellata* Catling, *Urtica dioica* var. *procera* (Muhl.) Wedd., *Vernonia gigantea* var. *gigantea,* and *Vitis aestivalis* var. *aestivalis.*

DISCUSSION

Park managers often need to know how a park's flora relates to the flora of the region in which the park occurs. This adds to our knowledge of how well parks represent the flora of a region and how much the region's flora is protected. In the case of Hopewell Culture, even though the park is small in area, the total number of taxa represents 40% of the species, 57% of the genera, and 76% of the families of Ross County, which is fairly good representation. Even more remarkable is the representation of the flora of Ohio: 17% of the species, 35% of the genera, and 56% of the families. Either the park is unusually rich for its size, or other comparably sized areas are being undersampled. Before this study was undertaken, the plant checklist for the park totaled 86 species, and this was estimated to be 20% of the total flora (A. Cusick, pers. comm.). This survey resulted in a total of 438 species, and the 86 species recorded before the study are exactly 20% of this total, suggesting that Cusick's estimate was quite accurate and the park's flora is not unusually rich.

It is worth noting that introduced species constitute 32% of the total number at the park. This is relatively high, but similar to other parks in the midwestern U.S. (Bennett 1996).

Published floras are usually never 100% complete because future collecting typically will discover more species. Although the collection effort for this study was fairly intensive, some species probably remain to be discovered. The species that are missing are probably a combination of the following:

- Spring ephemerals—this part of the flora was undersampled in three units, and not sampled at all in High Banks and Seip

- Grasses and sedges—these are difficult groups to sample
- Unidentified specimens (about 10)
- Species from earlier lists that were not found in this survey

Future field work should concentrate on these groups in order to complete the flora.

Although many national parks in the midwestern U.S. have fairly complete floras (80% known or more; Bennett 1996), many other parks across the country still need floristic studies. More such work is needed as parks become increasingly isolated in a man-made landscape. This study could serve as a model for floristic surveys of national parks in the future.

ACKNOWLEDGMENTS. This project would not have been possible without the generous cooperation and support of J. Neal, Superintendent of Hopewell Culture National Historical Park, and R. Burgoon, Chief of Interpretation and Resource Management. In addition, M. Walton, Director of the Veterans Affairs Medical Center, is thanked for providing accommodations throughout the summer. J. McMahon and D. Minney provided collections of the spring flora as well as numerous identifications throughout the season. Identifications also were made by J. Furlow and several graduate students of the Ohio State University Herbarium, T. Cochrane of the University of Wisconsin Herbarium, and A. Cusick, Chief Botanist of the Ohio Division of Natural Areas and Preserves of the Ohio Department of Natural Resources. We also thank J. Hapeman of the University of Wisconsin Herbarium for verifying the identification of the *Spiranthes* orchid. Lastly, we are very thankful for the meticulous review and excellent comments of an anonymous reviewer.

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RHODORA, Vol. 98, No. 894, pp. 168–179, 1996

NOTES ON THE GENUS *SCIRPUS* SENSU LATO IN MISSOURI

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ABSTRACT. The taxonomy of the Missouri members of the genus *Scirpus* sensu lato is discussed in light of recent classifications, and justifications are presented for segregating the 26 species into 5 genera: *Scirpus* sensu stricto, *Schoenoplectus*, *Bolboschoenus*, *Isolepis*, and *Trichophorum*. Nomenclature of the Missouri taxa is summarized. Three species (*Isolepis molesta*, *Schoenoplectus mucronatus*, and *Schoenoplectus purshianus*) and two putative hybrids (*Schoenoplectus acutus* × *tabernaemontani* and *Schoenoplectus acutus* × *heterochaetus*) are discussed as additions to the state's flora, and the status of three other recent additions (*Schoenoplectus deltarum*, *Schoenoplectus saximontanus*, and *Scirpus pedicellatus*) is updated.

Key Words: *Bolboschoenus*, Cyperaceae, *Isolepis*, Missouri botany, *Schoenoplectus*, *Scirpus*, taxonomy, *Trichophorum*

The genus *Scirpus* L. sensu lato occurs nearly worldwide and commonly is called "bulrush" in North America. As traditionally treated, it contains some 200–300 species (Tucker 1987). Of these, 48 were included in the last comprehensive treatment for North America (Beetle 1947), which is now outdated. Steyermark (1963) treated 19 species in Missouri. Because of subsequent range extension discoveries (see below) and the publication of several taxonomic studies, notably a revision of *Scirpus* sensu stricto (Schuyler 1963), the next summary of the state's flora (Yatskievych and Turner 1990) included 23 species. Other discoveries since, discussed below, have increased the number of bulrushes known to grow in Missouri to 26 species.

Most North American authors have accepted *Scirpus* in the broad sense, with a variety of species groups sometimes recognized as sections. Worldwide, it is the largest genus in the tribe Scirpeae and the third largest in the family Cyperaceae (Tucker 1987). The classification of species groups within *Scirpus* sensu

lato has remained controversial (cf. Tucker 1987). In contrast, in recent decades many authors outside of North America have divided *Scirpus* sensu lato into various segregate genera (e.g., Wilson 1981; Goetghebeur and Simpson 1991). They have accepted a narrower circumscription of *Scirpus* to include only about 30 leafy-stemmed species related to the conserved type of the genus, *Scirpus sylvaticus* L., of Europe. Recently, a few North American authors (e.g., Weber and Wittmann 1992; Strong 1994; Smith 1995; Browning et al. 1995) have begun to accept *Scirpus* sensu stricto and various segregates, although the number and circumscription of these segregate genera remain somewhat controversial. The underlying assumptions for the revised generic classification of the complex are that *Scirpus* sensu lato is polyphyletic (Goetghebeur 1986; Strong 1994; Bruhl 1995), and that the resultant smaller genera consist of more homogeneous species groups. Phylogenetic studies by Goetghebeur (1986) and Bruhl (1995) disagree in details, but both suggest that *Scirpus* sensu lato is polyphyletic. Bruhl's (1995) recent, comprehensive studies suggest that portions of the group (including *Bolboschoenus*, *Scirpus* sensu stricto, and *Trichophorum*) are part of a clade that includes *Dulichium* and *Fuirena*, whereas other portions (including *Isolepis* and *Schoenoplectus*) comprise part of a clade that includes *Eleocharis* and *Eriophorum*. However, Bruhl (1995) stresses that the Scirpeae are one of the most contentious groups on his cladogram, and that the tribe is perhaps the one portion of the family in greatest need of further taxonomic study. Our conclusion from these studies is that it seems most prudent to recognize as separate genera the series of apparently monophyletic units that are in use in much of the world's floristic literature, in spite of the need for further studies on phylogenetic and taxonomic relationships among these genera.

The present paper includes reports for three species and one variety new to the flora of Missouri. We also reconcile the more traditional monogeneric classification of *Scirpus* with current ideas concerning segregates by providing a key to genera and a summary of the currently recognized Missouri taxa, along with pertinent synonymy.

GENERIC SUMMARY

Preparation of a treatment of *Scirpus* sensu lato by A. E. Schuyler, S. G. Smith, W. J. Crins, and others for a forthcoming

volume of the Flora of North America (Oxford University Press, in prep.) has resulted in a revised classification for the temperate North American members of the group. This is in general agreement with the classification of Goetghebeur (1986) and Bruhl (1995), which formalized many ideas already in use in most of the recent floristic and taxonomic treatments of non-American Scirpeae. Morphological data supporting this classification were summarized by Goetghebeur (1986), Strong (1994), and Bruhl (1995). Smith (1995) published new combinations for various taxa to bring nomenclature into conformation with this scheme. Of the approximately nine genera that will be recognized in the Flora of North America treatment, five are represented in Missouri.

The following is a key to the genera segregated from *Scirpus* sensu lato based on species known from Missouri:

1. Stems with elongated internodes and thus leafy; leaf blades well developed, thin and flat; main involucral bract generally spreading, thin and flat like the leaf blades .. (2)
   2. Spikelets ca. 4–10 mm thick; spikelet scales minutely pubescent (the hairs often worn off), the midrib apex extended into a prominent awn; leaves lacking ligules; prominent corms generally present at shoot bases and on rhizomes ..... *Bolboschoenus*
   2. Spikelets ca. 1–3.5 mm thick; spikelet scales glabrous, the midrib not prominently extended; leaves with low, scarious ligules; corms lacking ..... *Scirpus*
1. Stems without evident internodes and thus leaves all basal, or rarely with one leaf in middle of stem; leaf blades well developed to rudimentary, thick and spongy to thin and flat; main involucral bract erect or sometimes bent to the side, thick and often superficially resembling the stem ..... (3)
   3. Spikelets 1–3 per stem, ca. 2–8 mm long, sessile at stem apex; involucral bract 1(2); achenes 0.7–2 mm long; plants densely cespitose ..... (4)
      4. Spikelet 1; achenes with 3–6 bristles; leaf blades 0.8–2 mm wide ..... *Trichophorum*
      4. Spikelets 1–3; achenes lacking bristles; leaf blades to 0.5 mm wide ..... *Isolepis*

3. Spikelets 1–100+ per stem, ca. 2–24 mm long, sessile at stem apex or many on branches; involucral bracts 1 to several; achenes ca. 1.2–4.5 mm long; plants spreading by long rhizomes or densely cespitose .... *Schoenoplectus*

LIST OF TAXA

The list below includes taxa of *Scirpus* and its segregates accepted for Missouri. Synonymy given here includes basionyms, as well as names that were used by Steyermark (1963) and other recent floras for the region.

Scirpus sensu stricto

1. *Scirpus atrovirens* Willd.
   Scirpus atrovirens f. *sychnocephalus* (Cowles) S.F. Blake
2. *Scirpus cyperinus* (L.) Kunth
   Eriophorum cyperinum L.
   Scirpus cyperinus var. *pelius* Fernald
   Scirpus rubricosus Fernald
3. *Scirpus divaricatus* Elliott
4. *Scirpus georgianus* R.M. Harper
   Scirpus atrovirens Willd. var. *georgianus* (R.M. Harper) Fernald
5. *Scirpus pallidus* (Britton) Fernald
   Scirpus atrovirens Willd. var. *pallidus* Britton
6. *Scirpus pedicellatus* Fernald
7. *Scirpus pendulus* Muhl. ex Elliott
   Scirpus lineatus auct., non Michx.
8. *Scirpus polyphyllus* Vahl

Schoenoplectus

9. *Schoenoplectus acutus* (Muhl. ex Bigelow) Á. Löve & D. Löve var. *acutus*
   Scirpus acutus Muhl. ex Bigelow
10. *Schoenoplectus americanus* (Pers.) Volkart ex Schinz & R. Keller
    Scirpus americanus Pers.
    Scirpus olneyi A. Gray
11. *Schoenoplectus deltarum* (Schuyler) Soják
    Scirpus deltarum Schuyler

12. *Schoenoplectus etuberculatus* (Steud.) Soják
    Rhynchospora etuberculata Steud.
    Scirpus etuberculatus (Steud.) Kuntze
13. *Schoenoplectus hallii* (A. Gray) S.G. Smith
    Scirpus hallii A. Gray
    Scirpus supinus L. var. *hallii* (A. Gray) A. Gray
14. *Schoenoplectus heterochaetus* (Chase) Soják
    Scirpus heterochaetus Chase
15. *Schoenoplectus mucronatus* (L.) Palla
    Scirpus mucronatus L.
16a. *Schoenoplectus pungens* (Vahl) Palla var. *pungens*
    Scirpus pungens Vahl
    Scirpus americanus auct., non Pers.
16b. *Schoenoplectus pungens* var. *longispicatus* (Britton) S.G. Smith
    Scirpus americanus Pers. var. *longispicatus* Britton
    Scirpus americanus var. *polyphyllus* (Boeck.) Beetle in part (epithet of uncertain application; see Koyama 1962)
17. *Schoenoplectus purshianus* (Fernald) M. Strong
    Scirpus purshianus Fernald
18. *Schoenoplectus saximontanus* (Fernald) J. Raynal
    Scirpus saximontanus Fernald
    Scirpus supinus L. var. *saximontanus* (Fernald) T. Koyama
19. *Schoenoplectus subterminalis* (Torr.) Soják
    Scirpus subterminalis Torr.
20. *Schoenoplectus tabernaemontani* (C.C. Gmel.) Palla
    Scirpus tabernaemontani C.C. Gmel.
    Scirpus validus Vahl
    Schoenoplectus validus (Vahl) Á. Löve & D. Löve
    Scirpus validus var. *creber* Fernald
21. *Schoenoplectus torreyi* (Olney) Palla
    Scirpus torreyi Olney

Bolboschoenus

22. *Bolboschoenus fluviatilis* (Torr.) Soják
    Scirpus maritimus L. *β fluviatilis* Torr.
    Scirpus fluviatilis (Torr.) A. Gray
    Schoenoplectus fluviatilis (Torr.) M. Strong
23. *Bolboschoenus maritimus* (L.) Palla ssp. *paludosus* (A. Nelson) T. Koyama

Scirpus paludosus A. Nelson
Scirpus maritimus L. var. *paludosus* (A. Nelson) Kük.
Bolboschoenus paludosus (A. Nelson) R. Soó
Bolboschoenus maritimus (L.) Palla ssp. *paludosus* (A. Nelson) Á. Löve & D. Löve

Isolepis

24. *Isolepis carinata* Hook. & Arn. ex Torr.
Scirpus carinatus (Hook. & Arn. ex Torr.) A. Gray (1868), non *Scirpus carinatus* Smith (1809)
Scirpus koilolepis (Steud.) Gleason
Isolepis koilolepis Steud.
25. *Isolepis molesta* (M.C. Johnst.) S.G. Smith
Scirpus molestus M.C. Johnst.

Trichophorum

26. *Trichophorum planifolium* (Muhl.) Palla
Scirpus planifolius Muhl. (1817), non *Scirpus planifolius* Grimm (1767)
Scirpus verecundus Fernald

NEW RECORDS FOR MISSOURI

The following three species were added to Missouri's flora during the time between the publication of Steyermark's (1963) flora and Yatskievych and Turner's (1990) checklist: *Scirpus pedicellatus*, *Schoenoplectus deltarum*, and *Schoenoplectus saximontanus*. County occurrences and voucher specimens for these additions were given (as *Scirpus*) by Turner and Yatskievych (1992) and are updated briefly here.

Scirpus pedicellatus. Although Steyermark (1963) excluded this segregate of *Scirpus cyperinus* from Missouri, Schuyler (1963) noted it from Adair and Macon Counties. Turner and Yatskievych (1992) cited an additional record from Putnam County. Subsequent herbarium searches have not expanded the range beyond these counties.

Schoenoplectus deltarum. This species in the "*Schoenoplectus pungens* complex" (including *Schoenoplectus americanus* and *Schoenoplectus pungens*) was described by Schuyler (1970, as

Scirpus deltarum), who included Missouri records from Holt and Howard Counties. It is very similar to *Schoenoplectus pungens* but has some characteristics of *Schoenoplectus americanus*. Although the Howard County specimen is typical of *Schoenoplectus deltarum* in achene and bristle morphology, the Holt County specimen lacks mature achenes and seems somewhat atypical for *Schoenoplectus deltarum*. Instead, it may represent an aberrant specimen of *Schoenoplectus pungens* or a hybrid between *Schoenoplectus pungens* and *Schoenoplectus americanus* (S. G. Smith, unpubl.). Several other collections from southern Missouri have the increased spikelet number typical of *Schoenoplectus deltarum*, but are otherwise typical of *Schoenoplectus pungens*.

Schoenoplectus saximontanus. Castaner (1984) first reported this species (as *Scirpus saximontanus*) for Missouri from Platte County in the northwestern part of the state. The following specimen has been collected since then in eastern Missouri, near St. Louis: St. Charles County, U.S. Army Corps of Engineers Riverlands National Environmental Demonstration Area, just S of Alton, Illinois near SW bank of Mississippi River, in wet, sandy depression, 38°52′15″N, 90°12′30″W, 16 Oct 1992, *R. H. Mohlenbrock s.n.* (MO). The site is a bottomland prairie/marsh complex that has been impacted heavily by previous farming in the area, as well as construction of nearby levees. Both of the Missouri stations are natural wetlands and it is difficult to speculate whether this species is a recent introduction into Missouri. However, as with *Schoenoplectus mucronatus* and *Schoenoplectus purshianus*, the most likely explanation for the establishment of these populations is that achenes were transported in the guts or in mud on the feathers or feet of migratory waterfowl (see also *Schoenoplectus purshianus* below).

Recent herbarium research has documented the existence of two presumed interspecific hybrids in Missouri. Field and herbarium studies also resulted in the discovery of three additional species for the state that are reported here for the first time.

Schoenoplectus acutus* × *tabernaemontani. The following specimens represent putative hybrids between *Schoenoplectus acutus* and the closely related *Schoenoplectus tabernaemontani*: Lafayette County, South Fork Fen, 3.5 mi SSE of Waverly, 12

June 1996, *S. G. Smith 8822* (MO); Saline County, lakes, Arrow Rock, 1 Sep 1929, *J. H. Kellogg 15128* (MO); St. Charles County, Marais Temps Clair Wildlife Area, 10 July 1985, *A. Christ s.n.* (MO). These specimens consist of soft-stemmed plants with floral scale color and morphology intermediate between the two putative parents. The Lafayette County specimen lacks achenes, but the Saline and St. Charles County collections appear to have fully-formed achenes. Interspecific hybridization in this complex was studied by Smith (1969), Dabbs (1971), and Shay et al. (1988), who noted that hybrids appear most frequently in disturbed habitats and that the parental taxa are separable taxonomically throughout much of their North American ranges. Several other specimens we have seen that we have identified as *Schoenoplectus acutus* are probably "introgressants" from *Schoenoplectus tabernaemontani*. Further instances of hybridization between *Schoenoplectus acutus* and *Schoenoplectus tabernaemontani* may be expected in northern Missouri, as most of the wetlands in this part of the state have been impacted heavily and repeatedly by agriculture and other physical and hydrological perturbations.

Schoenoplectus acutus* × *heterochaetus* [*Schoenoplectus* ×oblongus*** (Koyama) Soják]. The following specimen is intermediate morphologically between *Schoenoplectus acutus* and *Schoenoplectus heterochaetus* and is presumed to be a hybrid: St. Louis County, Pinks Lake, Allenton, 10 May 1897, *J. H. Kellogg s.n.* (MO). In addition, the illustration labeled *Scirpus acutus* in Steyermark's (1963) Flora of Missouri (Plate 77, Figure 2) shows a keeled achene and open inflorescence typical of this hybrid, and may well be drawn at least in part from a hybrid plant. This hybrid is relatively common throughout the North American range of *Schoenoplectus heterochaetus* (S. G. Smith, unpubl.).

Schoenoplectus mucronatus. This species is a native of Eurasia that has become naturalized in California in rice fields and waste places since at least 1947 (Bellue 1947; Mason 1957; Smith et al. 1993; S. G. Smith, unpubl.). It is known from a few localities in the eastern United States and adjacent Canada, where it apparently does not persist. It has been reported recently from Illinois (Schwegman 1984), Tennessee (Churchill 1992), and southwestern Iowa (Wilson 1992). The following eastern Missouri specimen was determined previously as *Schoenoplectus*

pungens: Lincoln County, Cuivre River State Park, edge of Lake Lincoln, in cove where old road goes down to man-made lake, T49N R1E S9, 28 June 1987, *B. Schuette 1502* (MO).

Schoenoplectus mucronatus is similar superficially in its trigonous culms to the more robust, widespread *Schoenoplectus pungens*, but differs in its densely tufted growth form, with the short rhizomes obscured by the culm bases (vs. spreading by elongate rhizomes in *Schoenoplectus pungens*); inflorescence bract generally bent to one side (vs. strictly erect); lack of leaf blades; spikelet scales mucronate and entire (vs. apex prominently awned and notched); and achenes rugose (smooth in *Schoenoplectus pungens*).

As with the Missouri records of *Schoenoplectus purshianus* (see below), the recent new records of *Schoenoplectus mucronatus* in Iowa, Illinois, and Missouri were collected in man-made wetlands, mostly of relatively recent origin. The most likely explanation for these new populations is that achenes are transported in the guts or in mud on the feathers or feet of migratory waterfowl, which depend upon such artificial wetlands in a landscape where most of the natural aquatic habitats have been destroyed or altered during the past few centuries since colonization by Europeans. It seems likely that these species will continue to expand their ranges in the future.

Schoenoplectus purshianus, new to Missouri. This native of the eastern United States is reported here for the first time from Missouri based on the following collection: Washington County, YMCA of the Ozarks, 2.5 mi N of Shirley, W shore of Sunnen Lake (an artificial lake), T37N R1E S9, 27 Sep 1990, *G. Yatskievych 90-423* (MO). As suggested above, this population is undoubtedly of recent origin.

Several authors (e.g., Voss 1972) included *Schoenoplectus purshianus* within the closely related *Schoenoplectus smithii*, which is somewhat more northern in distribution and not known from Missouri. It differs from *Schoenoplectus smithii* in several characters, including its mostly thicker and rounded-obovate (vs. mostly cuneate-obovate) achenes; its stouter bristles, which are usually present in *Schoenoplectus purshianus*, but often absent in *Schoenoplectus smithii*; and its generally shorter and often divergent inflorescence bract (always erect in *Schoenoplectus smithii*).

Schoenoplectus purshianus, *Schoenoplectus hallii*, and *Schoen-*

oplectus saximontanus are very similar in their small, densely tufted habit with culms very variable in length in the same tuft. They belong to two different taxonomically difficult complexes of the Old and New Worlds. In the North American flora, *Schoenoplectus mucronatus*, *Schoenoplectus purshianus*, and *Schoenoplectus smithii* belong to section *Actaeogeton* (Rchb.) J. Raynal, whereas *Schoenoplectus saximontanus*, *Schoenoplectus hallii*, and *Schoenoplectus erectus* (Poir.) Palla ex J. Raynal (incl. *Scirpus erismanae* Schuyler and *Scirpus wilkensii* Schuyler) belong to section *Supini* (Cherm.) J. Raynal (Raynal 1976). Members of sections *Actaeogeton* and *Supini* somewhat resemble the *Schoenoplectus pungens* complex, but are usually less robust and are densely tufted and annual (or apparently so), with rhizomes hidden among the shoot bases. The following key distinguishes all Missouri members of sections *Actaeogeton* and *Supini*:

1. Leaves all basal; achene surface rugose to nearly smooth; leaf sheaths lacking flowers or achenes ..... *Schoenoplectus* section *Actaeogeton* (2)
2. Culms cylindric, ca. 1-2 mm thick ..... *Schoenoplectus purshianus*
2. Culms strongly trigonous, ca. 2-5 mm thick ..... *Schoenoplectus mucronatus*

1. Leaves basal and 1 on culm; achene surface generally prominently transversely ridged; basal leaf sheaths often enclosing flowers or achenes ..... *Schoenoplectus* section *Supini* (3)
3. Achenes in spikelets strongly and nearly equilaterally trigonous; styles in spikelets trifid ..... *Schoenoplectus saximontanus*
3. Achenes in spikelets lenticular or obscurely compressed-trigonous; styles in spikelets bifid ..... *Schoenoplectus hallii*

Isolepis molesta. This diminutive species was first described (as *Scirpus molestus*) by Johnston (1964) from Arkansas, Louisiana, and Texas. We here report it for Missouri for the first time based on the following three collections from southwestern and southeastern Missouri, all more than 50 years old: Dade County, sandstone bluffs and glades along Sinking Creek, a tributary of Turnback Creek, 2.5 mi SW of Everton, T30N R26W S23/24, 7

May 1939, *J. A. Steyermark 22292* (F); Dunklin County, in open soil, low flat ground surrounded by *Quercus phellos* woods about 5 mi NW of Campbell, 5 Apr 1931, *J. A. Steyermark 386* (MO); Jasper County, low sandy woods, Smithfield, 28 May 1931, *J. H. Kellogg s.n.* (MO).

The Missouri collections originally were determined as the very similar, but more common and widespread, *Isolepis carinata* [as *Scirpus koilolepis* (Steud.) Gleason]. The two differ mainly in that *I. molesta* has achenes 0.7–0.9 mm long with the pinkish-brown surface covered with a thick, whitish, waxy coating and spikelet scales 1.0–1.3 mm long, whereas *I. carinata* has achenes 1.0–1.5 mm long with the orangish-brown surface usually lacking a waxy coating and spikelet scales 1.8–2.0 mm long. Although the two species sometimes grow together, intermediates have not been noted (Johnston 1964; S. G. Smith, unpubl.).

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RHODORA, Vol. 98, No. 894, pp. 180–216, 1996

THE FLORA OF LATIMER POINT AND VICINITY, NEW LONDON COUNTY, CONNECTICUT

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ABSTRACT. A long-term floristic study of the macroalgae, bryophytes, and vascular plants in the vicinity of Latimer Point, Stonington, New London County, Connecticut was made from 1969 to 1992. Four-hundred twenty-seven taxa were found including 30 marine macroalgae, 12 mosses, 10 ferns and fern allies, 1 conifer, and 374 flowering plants. Five species are reported as new to southeastern Connecticut: *Cuscuta pentagona, Eschscholzia californica, Poa palustris, Stachys byzantina,* and *Viola priceana.* Two species listed as endangered in Connecticut are known from the area, *Angelica lucida* and *Ligusticum scothicum,* and one species listed as of special concern, *Honckenya peploides,* is also present. Changes in composition of the terrestrial flora during the 25 year period include the invasion of *Ailanthus altissima, Elaeagnus umbellata,* and *Paulownia tomentosa,* an increase in populations of 14 exotic species, and the decline of six native species.

Key Words: New England, floristics, Connecticut, coastal plants, bryophytes, marine algae

This flora is the result of an exploration of Latimer Point and its vicinity (including coastal islands) started during 1969 while I was an undergraduate at Bates College in Lewiston, Maine. The site was chosen because my family had built a small cottage on the tip of Latimer Point in the late 1960s, and repeated visits during the next 24 years allowed me to monitor the flora until the property was sold in 1993. I am aware of no other botanists who have sampled the area during this period.

The study area is on the Mystic 7.5 min. U.S.G.S. topographic quadrangle. It is coastal, along the northern shore of Fishers Island Sound (Figures 1 and 2) within the town of Stonington, at the east side of the community of Mystic. It includes the areas between Pequotsepos Brook on the west to Quiambog Cove to the east on both sides of US Rt. 1 (generally between Lords Point and Mason Island). It extends south to the Sound and includes Lyddy, Andrews, and Dodges Islands.

The surface geology is made up of till from the Wisconsin glaciation (dating to about 14,000 B. P.) which includes numerous

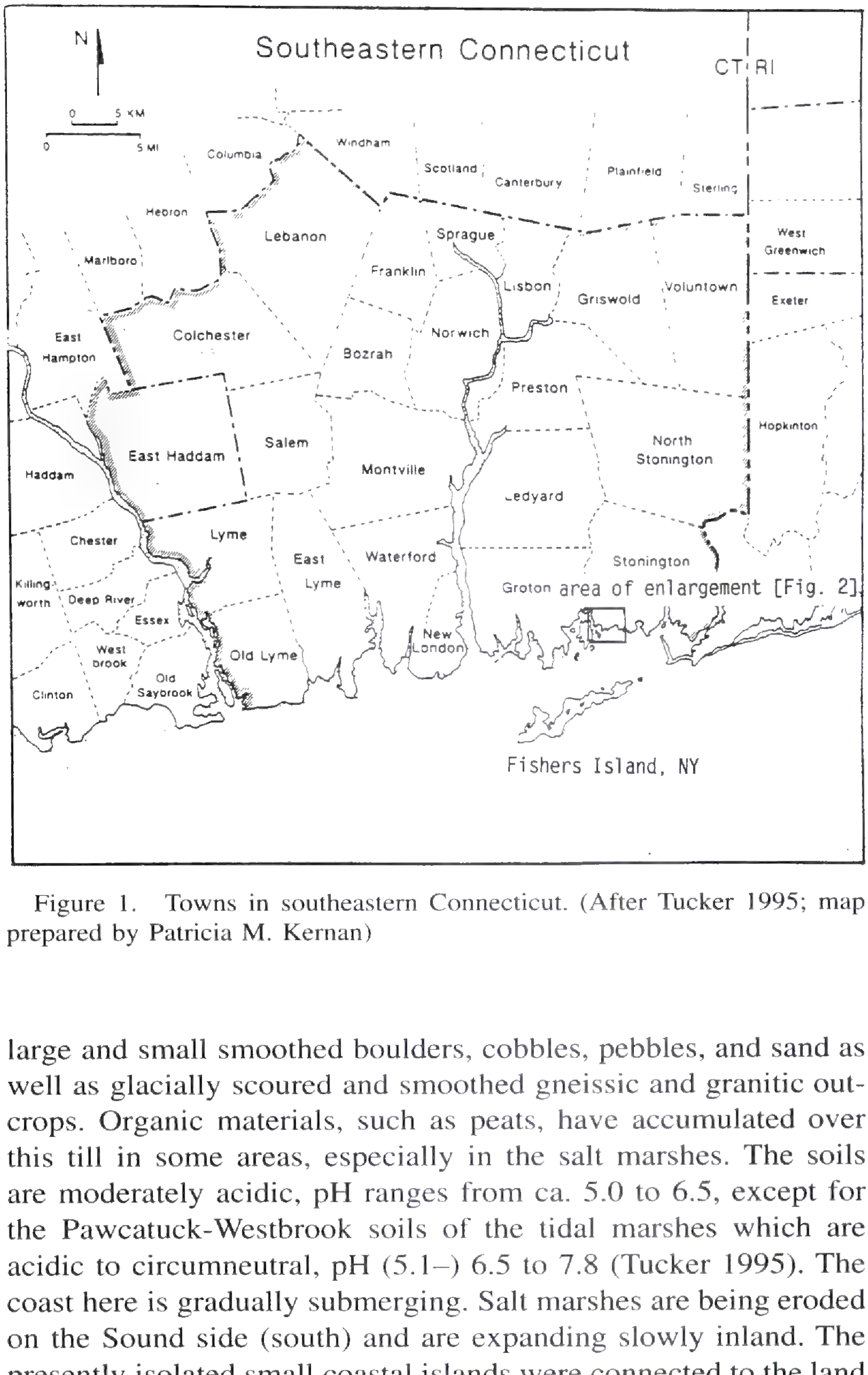

Figure 1. Towns in southeastern Connecticut. (After Tucker 1995; map prepared by Patricia M. Kernan)

large and small smoothed boulders, cobbles, pebbles, and sand as well as glacially scoured and smoothed gneissic and granitic outcrops. Organic materials, such as peats, have accumulated over this till in some areas, especially in the salt marshes. The soils are moderately acidic, pH ranges from ca. 5.0 to 6.5, except for the Pawcatuck-Westbrook soils of the tidal marshes which are acidic to circumneutral, pH (5.1–) 6.5 to 7.8 (Tucker 1995). The coast here is gradually submerging. Salt marshes are being eroded on the Sound side (south) and are expanding slowly inland. The presently isolated small coastal islands were connected to the land by sand ridges and salt marsh less than 100 years ago and were used as cow pastures according to long-time residents with whom

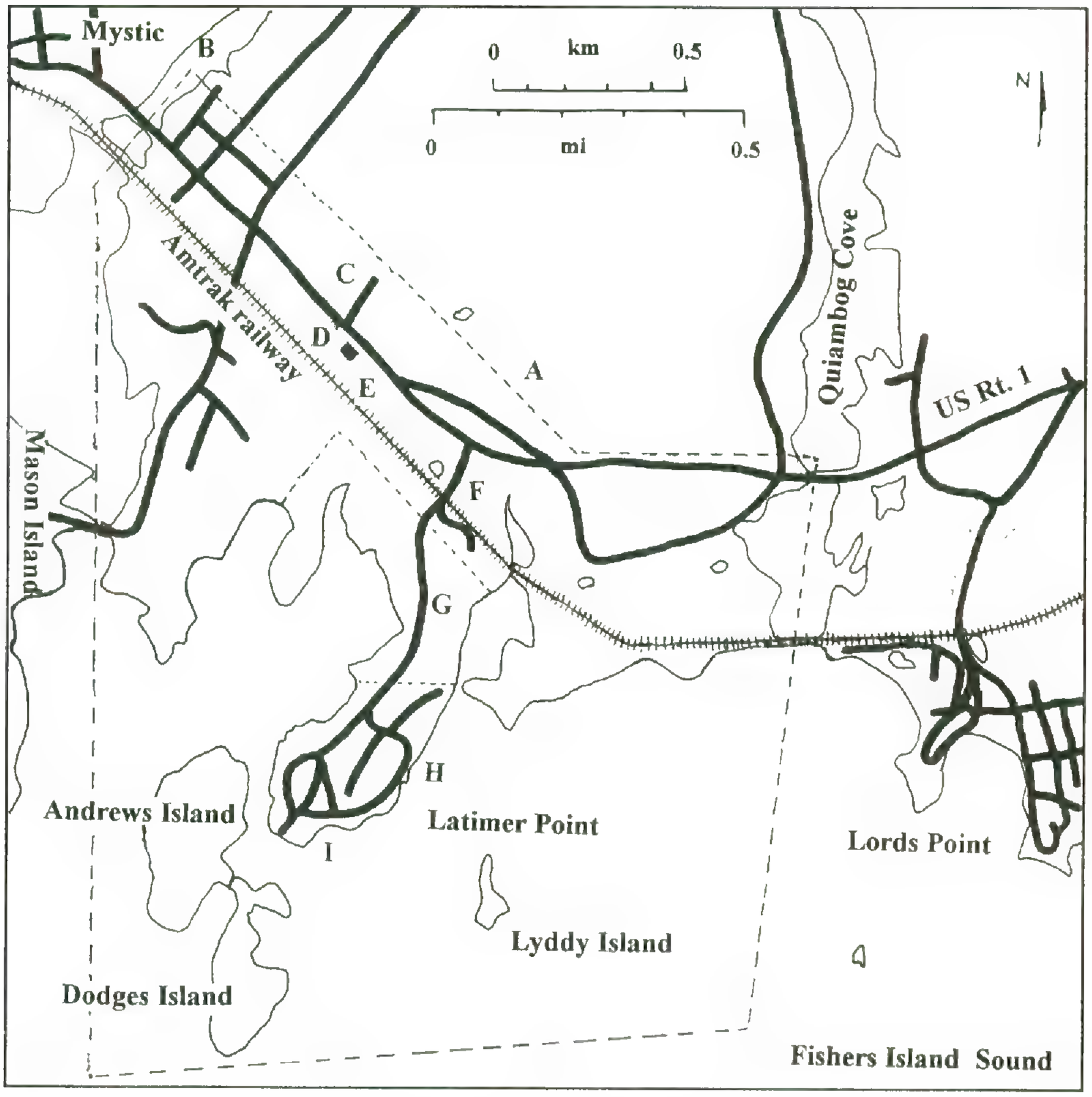

Figure 2. Latimer Point and vicinity. A. study area boundary; B. Pequotsepos Brook; C. Long Wharf Road; D. VFW post; E. old landfill; F. Latimer Point Road; G. nature preserve (The Nature Conservancy); H. back beach; I. main beach.

I spoke. These connections are now under water, though shallow at low tide.

The region's forests were cut in the 1700s and 1800s and the area became pasture. The area was not cultivated due to the extremely rocky nature of the soils. Since about the 1930s the oak forests have grown back and only an occasional tree has been harvested for fuel. From the 1960s to the present, areas along US Rt. 1 have been cleared again and developed for business and housing, but Latimer Point itself has had no additional development.

About a third of Latimer Point is owned and protected by The

Nature Conservancy. This protected land includes oak forest, tidal marshes, and assorted tidal rocks. The southern half of the peninsula is residential, with a small number of family cottages on small lots, two private beaches and a recreational field. The remainder of the peninsula is public land and Amtrak railroad right-of-way. Lyddy Island is located just off the southern tip of the point, and Dodges and Andrews Islands are located just to the southwest of the point. The islands are smoothed granitic outcrops liberally covered with glacial till. The southwestern tip of Latimer Point historically was the site of a fish processing factory. The soils are dark and humus-rich in this area. Ruins of the factory still can be seen behind an old retaining wall. Just east of the point is an inlet and then an isolated sand/gravel beach which proceeds east towards Lords Point. Thompson (1950) presents an interesting history of the area including Latimer Point.

Latimer Point is located in an area where a more northern flora with arctic affinities meets the temperate coastal plain floras of the eastern United States. Information on species ranges for taxa in this list can be obtained from Gleason and Cronquist (1991). Species approaching their southern limits include *Angelica lucida* (Long Island to Labrador, north Pacific to northern Asia), *Ligusticum scothicum* (Long Island to arctic Greenland and northern Europe) and *Plantago maritima* (circumboreal, south to New Jersey). Species approaching their northern limits include *Athyrium filix-femina* var. *asplenioides* (on the east coast from Florida north to Rhode Island), *Baccharis halimifolia* (on the east coast from Florida north to Massachusetts), and *Dioscorea villosa* (on the east coast from Florida north to Connecticut). The study area is significant also because it is one of the few coastal areas of southern New England that has had little development since the 1960s. No new homes have been built on Latimer Point since that time and the extent of the habitats has remained essentially unchanged.

Tucker (1995) described 12 plant associations in southeastern Connecticut: Ponds and Lakes, Coastal Beaches and Dunes, Estuaries, Tidal Marshes, Freshwater Marshes, Shrub Swamps, Red Maple Swamps, Oak and Oak-Hickory Forests, Old Fields and Pastures, Pastures and Lawns, Cropland and Gardens, and Roadsides. Since some of these associations (which are termed habitats in this paper) on Latimer Point are very poorly developed and overlap considerably with others, I have adapted and modified them to result in the following seven habitats in the study area:

1. **Estuaries**. This habitat is extensive and well developed in the study area, making up most of the shallow waters on the east and west sides of the point. It here includes both saline and brackish waters and their associated sandbars and mudflats from 0 to 3 m deep that are part of the northern portion of Fishers Island Sound. These areas are dominated by seaweeds and *Zostera* depending on substrate, currents, and salinity.

2. **Coastal beaches and dunes.** These are rocky, gravelly beaches with sand, and are well developed only along the beach to the east of the Point. The two beaches (the main and back beaches) of Latimer Point itself are maintained artificially; new sand is brought in by the residents nearly every year to replenish sand washed out into the Sound in winter storms. There are small natural beaches on Lyddy Island and Dodges Island but their coasts are mostly rocky with numerous small to huge, smoothed, glacial boulders. The beaches are dominated by halophytes such as *Ammophila*, *Cakile*, and members of the Chenopodiaceae.

3. **Tidal marshes**. Well-developed tidal marshes occur northwest and northeast of the Point, at the southern end of Andrews Island, the northern end of Dodges Island, and on a small portion of Lyddy Island. These are dominated by *Distichlis*, *Iva*, *Limonium*, *Spartina*, and members of the Chenopodiaceae.

4. **Freshwater marshes.** This includes ponds and lakes. Poorly developed freshwater marshes occur along the northern side of the Amtrak railroad right-of-way and along US Rt. 1. Most of those along the railroad were formed when the elevated right-of-way prevented the influx of brackish water into former tidal areas, changing them into freshwater systems. These are dominated by sedges, *Hibiscus*, and various shrubs. One pond with water lilies is located at the northeast side of the railroad tracks just southwest of the junction of US Rt. 1 and Latimer Point Road; while normally full of water all year, this pond dries completely in drought years.

5. **Shrub swamps.** This includes Red maple swamps. Poorly developed shrub swamps occur alongside the freshwater marshes; perhaps the best developed is at the southwest side of the junction of US Rt. 1 and Latimer Point Road. They are dominated by

indigenous species of *Acer*, *Clethra*, *Rhododendron*, *Salix*, and *Vaccinium*.

6. **Oak forest.** Rather well-developed secondary growth oak forest, perhaps better termed maritime oak forest, occurs on the northern half of Latimer Point and on the peninsula just to its northwest. The trees grow among large boulders in very rocky soil. This habitat is dominated by *Amelanchier*, *Quercus*, *Smilax*, *Vaccinium*, and *Vitis*.

7. **Disturbed land.** This includes old fields and pastures, pastures and lawns, croplands and gardens, and roadsides of Tucker (1995). Also included here are railroad rights-of-way. Only small residence gardens are found on the Point, but some cleared fields and an old landfill, as well as a few businesses, are found along US Rt. 1. Most of the diversity is due to introduced European weeds and casual escapes from cultivation.

MATERIALS AND METHODS

Tucker (1995) has treated the entire vascular flora in the area of southeastern Connecticut, which includes the area in this paper. With a few exceptions, I have followed the nomenclature used in that paper. Gleason and Cronquist (1991) has also served as a nomenclatural reference. Synonyms have been included if they commonly are used as accepted names in other regional floras and manuals. Nomenclature for the marine algae follows Schneider and Searles (1991).

Information on plants listed as endangered, threatened, or of special concern in Connecticut was obtained from the Natural Diversity Data Base maintained by staff at the Natural Resources Center, Connecticut Department of Environmental Protection in Hartford (pers. comm., 1996).

While I collected and observed the flora in the vicinity of Latimer Point for over two decades, there are still undoubtedly some taxa (especially algae and bryophytes) that I did not collect due to oversight or due to some nook or cranny that remained unexplored. The islands were accessed by small boat and the rest of the area was explored on foot.

The plants are listed first by major group, division, or class, and then alphabetically by family and scientific name. The flora

was documented by means of voucher specimens preserved according to standard herbarium techniques (Hill 1995). These voucher specimens have been deposited in several herbaria (cited after the specimens) indicated by acronyms as published in *Index Herbariorum* (Holmgren et al. 1990) with the exception of the personal herbarium of the author (srh), and the herbarium at Trinity College, Hartford, CT (tr). All specimens cited were collected by the author. The Hill collection numbers and years of collection were as follows: 1969: *576–697* (not a mistake—these were numbered later); 1970: *293–330*; 1971: *788–801*; 1972: *924–953*; 1973: *1152–1245*; 1978: *7413–7445*; 1979: *8718–8755*; 1980: *9104–9449*; 1981: *10062–10804*; 1982: *11802–11834*; 1983: *11855–13222*; 1986: *17061–17063*; 1987: *18645–18650*; 1988: *19714–19804*; 1989: *20806–20807*; 1990: *21599–21798*; 1991: *22471–22518*; 1992: *23081–24186*.

RESULTS

The species listings below contain the following data: * = non-native species; Scientific name (with major synonyms in brackets); Common name (if known); Frequency: Abundant (locally dominant), Frequent (common), Occasional, Infrequent (uncommon), Scarce (rare); Plant habitat: as above; Temporal status: Increasing (becoming more frequent during observation period), Declining (becoming less frequent during observation period), Stable (population neither increasing nor declining), Waif (may not persist, seen once); Collection number; Herbaria where specimens were deposited.

CHLOROPHYCOPHYTA (Green Algae)

Bryopsis plumosa (Hudson) C. Agardh. Infrequent, Estuaries, Stable. *931* (VT).

Cladophora cf. *albida* (Hudson) Kutz. Occasional, Estuaries, Increasing. *21678* (srh).

Cladophora sericea (Hudson) Kutz. Occasional, Estuaries, Stable. *18646* (srh, CLEMS); *21677* (srh).

Codium fragile (Suringar) Hariot subsp. *tomentosoides* (van Goor) Silva. Frequent, Estuaries, Stable. *580A* (VT); *580B* (VT); *18645* (srh, CLEMS, FH, MARY, MO, NY, USF, NY).

Enteromorpha intestinalis (L.) Link. Occasional, Estuaries, Stable. *18647* (srh, CLEMS, FH, MO, NY, VT).

Enteromorpha sp. Occasional, Estuaries, Stable. *576* (VT); *21671* (srh, tr, CLEMS).

Ulva lactuca L., Sea lettuce. Frequent, Estuaries, Stable. *21674* (srh, tr, CLEMS, NY, PE, TAES, USF, WVA).

CYANOPHYCOPHYTA (Blue-Green Algae)

Lyngbya aestuarii Lieb. Scarce, Estuaries, Stable. *20807* (srh).

PHAEOPHYCOPHYTA (Brown Algae)

Ascophyllum nodosum (L.) Le Jol., Rock kelp. Frequent, Estuaries, Stable. *21681* (srh, tr, CLEMS, NY, TAES, USF, WVA).

Chorda filum (L.) Stackhouse. Occasional, Estuaries, Stable. *606* (VT); *21667* (srh, tr, CLEMS, NY).

Cladosiphon zosterae (J. Ag.) Kylin. Occasional, Estuaries, Stable. *610* (VT as *Eudesme zosterae*); *21672* (srh, CLEMS).

Elachista fucicola (Vell.) Aresch. Infrequent, Estuaries, Stable. *21676* (srh).

Fucus vesiculosus L., Rockweed. Abundant, Estuaries, Stable. *10144* (srh, FH, MARY, NY, TAES, VT); *21679* (srh, tr, CLEMS, FH, NY).

Laminaria saccharina (L.) Lamouroux (distrib. as *L. agardhii* Kjellman), Kelp. Frequent, Estuaries, Stable. *612A* (VT); *21670* (srh, tr, CLEMS, NY).

Leathesia difformis (L.) Aresch. Infrequent, Estuaries, Declining? *615* (VT).

Scytosiphon lomentaria (Lyngb.) Link. Occasional, Estuaries, Stable. *21680* (srh, tr, CLEMS, FH, NY).

Stilophora rhizoides (Turner) J. Ag. Infrequent, Estuaries, Stable. *18648* (srh).

RHODOPHYCOPHYTA (Red Algae)

Antithamnion cruciatum (C. Ag.) Naeg. Infrequent, Estuaries, Stable. *21667A* (srh).

Ceramium rubrum (Huds.) C. Ag. Frequent, Estuaries, Stable. *21675B* (srh, tr, CLEMS, NY).

Champia parvula (C. Ag.) Harvey. Frequent, Estuaries, Stable. *585* (NCU, VT); *932* (VT); *21680B* (srh).

Chondria baileyana (Montagne) Harvey. Frequent, Estuaries, Stable. *586* (NCU, VT); *933* (VT); *18649* (srh); *18650* (srh, CLEMS).

Chondrus crispus Stackhouse, Irish moss. Frequent to Occasional, Estuaries, Declining. *19714* (srh, CLEMS, USCH).

Dasya baillouviana (Gmel.) Mont. Infrequent, Estuaries, Declining. *943* (VT as *Dasya elegans*); *21667B* (srh).

Gracilaria tikrahiae McLachlan [*Gracilaria foliifera* (Forsskal) Boergeson, misapplied]. Frequent, Estuaries, Stable. *591B* (VT); *21669* (srh, tr, CLEMS, NY).

Grinnellia americana (C. Ag.) Harvey. Infrequent, Estuaries, Stable. *21668* (srh).

Polysiphonia harveyi Bailey. Frequent, Estuaries, Stable. *21673* (srh, tr, CLEMS, NY).

Polysiphonia nigrescens (Huds.) Grev. Frequent, Estuaries, Stable. *21675A* (srh, tr, CLEMS, NY).

Polysiphonia sp. Frequent, Estuaries, Stable. *597* (VT).

Spermothamnion repens (Dillwyn) Rosenv. Infrequent, Estuaries, Stable. *18650A* (srh, CLEMS).

Spyridia hypnoides (Bory) Papenfuss. Occasional, Estuaries, Stable. *21680A* (srh).

BRYOPHYTA (Mosses)

Atrichum angustatum (Brid.) B. S. G. Occasional to Frequent, Oak forest, Stable. *21629* (srh, CLEMS, DUKE, MO, NY, TAES, USF).

Aulacomnium palustre (Hedw.) Schwaegr. Occasional, Shrub swamps, Stable. *21712* (srh, CLEMS, DUKE, NY).

Brachythecium acuminatum (Hedw.) Aust. Infrequent, Oak forest, Shrub swamps, Stable. *21719A* (srh, CLEMS, DUKE, FH, NY).

Bryum lisae De Not. var. *cuspidatum* (B. S. G.) Marg. Infrequent, Oak forest, Disturbed land, Stable. *21699* (srh, CLEMS, DUKE, NY).

Ceratodon purpureus (Hedw.) Brid. Occasional, Oak forest, Disturbed land, Stable. *21628* (srh, CLEMS, DUKE).

Heterophyllum affine (Hk.) Fleisch. Occasional, Oak forest, Stable. *22471* (srh, CLEMS, DUKE, MO, NY, USF).

Hypnum imponens Hedw. Occasional, Shrub swamps, Stable. *21710* (srh, CLEMS, DUKE, NY).

Plagiomnium cuspidatum (Hedw.) T. Kop. Occasional, Oak forest, Disturbed land, Stable. *21630* (srh, DUKE).

Polytrichum ohioense Ren. & Card. Infrequent, Oak forest, Shrub swamps, Stable. *21718* (srh, CLEMS, DUKE, FH).

Sphagnum sp., Sphagnum moss. Infrequent, Shrub swamps, Stable. *21711* (srh).

Steerecleus serrulatus (Hedw.) Robins. Infrequent, Shrub swamps, Stable. *21719* (srh, CLEMS, DUKE, FH, NY).

Thelia hirtella (Hedw.) Sull. Infrequent, Oak forest, Stable. *22471A* (srh, CLEMS, MO, NY, USF).

EQUISETOPHYTA (Horsetails)

EQUISETACEAE

Equisetum arvense L., Common horsetail. Scarce, Disturbed land, Stable. *21721* (srh, CLEMS, NYS).

POLYPODIOPHYTA (Ferns)

DENNSTAEDTIACEAE

Dennstaedtia punctilobula (Michx.) Moore, Hay-scented fern. Frequent, Oak forest, Disturbed land, Increasing. *21652* (srh, CLEMS, GH, KANU, NY, NYS, TAES, USF, UT).

Pteridium aquilinum (L.) Kuhn var. *latiusculum* (Desv.) Underw., Bracken fern. Frequent, Oak forest, Disturbed land, Stable. *9383* (srh, MARY, NY, TAES, VT).

DRYOPTERIDACEAE

Athyrium filix-femina (L.) Roth. var. *asplenioides* (Michx.) Farw., Southern lady fern. Infrequent, Shrub swamps, Stable. *21787* (srh, CLEMS, GH, LG, NY, TAES, UC, USF).

Onoclea sensibilis L., Sensitive fern. Occasional to Infrequent, Freshwater marshes, Shrub swamps, Stable. *21664* (srh, CLEMS, UC).

OSMUNDACEAE

Osmunda cinnamomea L., Cinnamon fern. Frequent, Shrub swamps, Stable. *9121* (srh, MARY, NY, VT); *10084* (BH, CLEMS, GH, MARY, MO, NY, SMU, TAES, VT).

Osmunda claytoniana L., Interrupted fern. Occasional to Infrequent, Shrub swamps, Declining. *10081* (srh, GH, MARY, MO, NY, TAES, VT).

Osmunda regalis L. var. *spectabilis* (Willd.) A. Gray, Royal fern. Occasional to Infrequent, Shrub swamps, Stable. *9381* (MARY, MO, NY, TAES, VT); *10070* (GH, MARY, NY, TAES, VT); *21693* (CLEMS, GH, NY, NYS).

THELYPTERIDACEAE

Thelypteris noveboracensis (L.) Nieuwl., New York fern. Occasional, Freshwater marshes, Shrub swamps, Stable. *21788* (srh, CLEMS, GH, NY, UC).

Thelypteris palustris Schott var. *pubescens* (Lawson) Fern., Marsh fern. Frequent, Freshwater marshes, Stable. *9378* (srh, MARY, NY, VT).

PINOPHYTA (Conifers)

CUPRESSACEAE

Juniperus virginiana L., Red-cedar. Frequent, Oak forest, Disturbed land, Stable. *939* (NCU, VT); *9409* (srh, MARY, NY, VT).

MAGNOLIOPHYTA (Flowering Plants)

LILIOPSIDA (Monocotyledons)

ALISMATACEAE

Alisma plantago-aquatica L. [*A. subcordatum* Raf.], Water-plantain. Scarce, Freshwater marsh, Stable. *21769* (srh, CLEMS, UNA).

AMARYLLIDACEAE

Hypoxis hirsuta (L.) Cov., Yellow star-grass. Scarce, Oak forest, Disturbed land, Stable. *22472* (USF).

ARACEAE

Arisaema triphyllum (L.) Schott ex Schott & Endl., Jack-in-the-pulpit. Scarce, Shrub swamps, Stable. *22514* (srh).

COMMELINACEAE

**Commelina communis* L., Day-flower. Infrequent, Disturbed land, Stable. *21651* (srh, BAA, CLEMS, CTES, GH, NY, NYS, TAES, USF).

CYPERACEAE

Bulbostylis capillaris (L.) Clarke, Hair sedge. Frequent to Occasional, Freshwater marsh, Disturbed land, Stable. *9363* (srh, MARY, MO, NY, TAES, VT).

Carex albicans Willd. var. *emmonsii* (Dewey) Rettig, Sedge. Occasional to Infrequent, Shrub swamps, Stable. *23087* (srh, CLEMS, MICH).

Carex blanda Dewey, Sedge. Occasional, Disturbed land, Stable. *23116* (srh, CLEMS, MICH, NY, TAES, USCH, USF).

Carex cephalophora Muhl., Sedge. Infrequent, Disturbed land, Stable. *10091* (srh, GH, MARY, MO, NY, TAES).

Carex crinita Lam., Sedge. Occasional, Freshwater marshes, Stable. *10097* (srh, GH, MARY, MO, NY, TAES, VT).

Carex debilis Michx. var. *rudgei* Bailey, Sedge. Infrequent, Shrub swamps, Stable. *21707* (srh, CLEMS, NYS).

Carex hormathodes Fern., Sedge. Occasional, Tidal marshes, Stable. *21697* (srh, CLEMS, GH, MICH, MO, NY, TAES, USCH, USF).

Carex intumescens Rudge, Sedge. Occasional, Freshwater marshes, Declining. *10090* (srh, GH, MARY, MO, NY, VT).

Carex longii Mack., Sedge. Occasional, Disturbed land, Tidal marshes, Stable. *21640* (srh, CLEMS, GH, MICH, MO, NY, USF); *21732* (CLEMS, MICH); *24186* (NY).

Carex pensylvanica Lam., Sedge. Occasional, Disturbed land, Oak forest, Stable. *23106* (srh, MICH).

Carex swanii (Fern.) Mack., Sedge. Occasional, Disturbed land, Stable. *21744* (srh, CLEMS, MICH, NY).

Carex vulpinoidea Michx., American fox sedge. Infrequent, Disturbed land, Freshwater marshes, Stable. *21726* (srh, CLEMS, GH, MICH, NY).

Cyperus diandrus Torr., Flatsedge. Occasional, Freshwater marshes, Declining. *9437* (srh, GH, MARY, MO, NY, TAES, VT; mixed with *9437A Fimbristylis autumnalis*).

Cyperus esculentus L., Yellow nut-sedge. Frequent to Occasional, Coastal beaches and dunes, Disturbed land, Stable. *950* (NY); *8718* (srh, MARY, NY, VT).

**Cyperus lupulinus* (Spreng.) Marcks subsp. *lupulinus* [*C. filiculmis* auth.]. Occasional, Disturbed land, Stable. *9405* (srh, MARY, NY, VT); *21764* (CLEMS). Said to be introduced according to Tucker (1995).

Cyperus lupulinus (Spreng.) Marcks subsp. *macilentus* (Fern.) Marcks. Scarce, Disturbed land, Stable. *21641* (srh).

Eleocharis obtusa (Willd.) Schult., Spikerush. Occasional, Freshwater marshes, Stable. *9359* (srh, MARY, MO, NY, TAES, VT).

Eleocharis olivacea Torr. [*E. flavescens* (Poir.) Urb. var. *olivacea* (Torr.) Gl.], Spikerush. Frequent to Occasional, Freshwater marshes, Stable. *9361* (srh, MARY, NY, TAES, VT).

Eleocharis palustris L. [*E. halophila* Fern. & Brackett], Saltmarsh spikerush. Occasional, Tidal marshes, Stable. *21695* (srh, NYS).

Fimbristylis autumnalis (L.) Roem. & Schult., Autumn fimbry. Occasional, Freshwater marshes, Stable. *9437A* (srh, GH, NY, VT; all mixed with *9437 Cyperus diandrus*).

Rhynchospora capitellata (Michx.) Vahl, Common beak-rush. Occasional, Dis-

turbed land, Freshwater marshes, Stable. *21739* (srh, CLEMS, GH, LG, NY, NYS, TAES, USF).

Scirpus cyperinus (L.) Kunth, Common wool-grass. Infrequent, Freshwater marshes, Stable. *9357* (srh, MARY, NY, TAES, VT).

Scirpus hattorianus Makino, Bulrush. Occasional, Freshwater marshes, Stable. *21757* (srh, CLEMS, MICH, NY, NYS).

Scirpus pungens Vahl [*S. americanus* auth.], Three-square. Frequent to Occasional, Tidal marshes, Stable. *1158* (VT); *9324* (srh, MARY, NY, TAES, VT).

Scirpus tabernaemontani Gmel. [*S. validus* auth.], Soft-stem bulrush. Scarce, Freshwater marshes, Stable. *21761* (srh, CLEMS, GH, LG, NY, NYS).

DIOSCOREACEAE

Dioscorea villosa L., Wild yam. Scarce, Oak forest, Stable. *9312* (srh, MARY, NY, VT).

IRIDACEAE

Iris prismatica Pursh, Small blue flag. Scarce, Freshwater marshes, Stable. *23085* (srh, CLEMS, NY).

Iris versicolor L., Wild iris. Scarce, Freshwater marshes, Stable. *23084* (NY).

Sisyrinchium montanum Greene, Blue-eyed grass. Infrequent, Disturbed land, Stable. *21742* (srh, CLEMS as *S. arenicola* Bickn.); *22476* (CLEMS, NY as *S. atlanticum* Bickn.).

JUNCACEAE

Juncus acuminatus Michx., Rush. Infrequent, Freshwater marshes, Disturbed land, Stable. *22510* (srh).

Juncus bufonius L., Toad rush. Infrequent, Freshwater marshes, Disturbed land, Stable. *21746* (srh, CLEMS, NYS).

Juncus canadensis J. Gay ex LaHarpe, Marsh rush. Occasional, Freshwater marshes, Disturbed land, Stable. *9362* (MARY, MO, NY, TAES, VT); *21735* (CLEMS, USF).

Juncus gerardii Loisel., Black grass. Frequent, Tidal marshes, Stable. *1157* (NY, VT); *9322* (srh, MARY, MO, NY, TAES, VT).

Juncus marginatus Rostk., Grass-rush. Infrequent, Freshwater marshes, Disturbed land, Stable. *21685* (srh, CLEMS); *21733* (CLEMS, NY).

Juncus tenuis Willd., Path rush. Occasional, Disturbed land, Stable. *9404* (srh, MARY).

Luzula campestris (L.) DC. var. *multiflora* (Retz.) Celak, Wood-rush. Infrequent to Scarce, Disturbed land, Stable. *10075* (GH, MARY, NY, TAES, VT).

JUNCAGINACEAE

Triglochin maritimum L., Arrow-grass. Frequent, Tidal marshes, Stable. *1159* (A, NY, VT); *7413* (srh, VT); *9323* (MARY, MO, NY, TAES, TEX, VT).

LILIACEAE

**Convallaria majalis* L., Lily-of-the-valley. Scarce, Disturbed land, Shrub swamps, Stable. *10078* (srh, MARY, VT).

Lilium superbum L., Turk's-cap lily. Scarce, Shrub swamps, Stable to Declining. *788* (VT); *17061* (srh).

Maianthemum canadense Desf., Wild lily-of-the-valley. Occasional, Oak forest, Shrub swamps, Stable. *10062* (srh, GH, MARY, MO, NY, TAES, VT).

**Muscari botryoides* (L.) Miller, Grape-hyacinth. Infrequent to Scarce, Disturbed land, Stable. *23117* (srh, CLEMS).

Polygonatum pubescens (Willd.) Pursh, Solomon's-seal. Scarce, Oak forest, Shrub swamps, Stable. *23089* (NY).

Smilacina racemosa (L.) Desf., False solomon's-seal. Scarce, Oak forest, Shrub swamps, Stable. *21781* (USF).

Uvularia perfoliata L., Perfoliate bellwort. Scarce, Oak forest, Stable. *10095* (srh, MARY, VT).

Uvularia sessilifolia L., Common bellwort. Infrequent, Oak forest, Shrub swamps, Stable. *10067* (srh, GH, MARY, NY, TAES, VT); *21780* (CLEMS); *23090* (NY).

POACEAE

Agrostis scabra Willd. [*A. hyemalis* (Walt.) BSP. var. *tenuis* (Tuckerm.) Gl.], Fly-away-grass. Occasional, Disturbed land, Stable. *21682* (srh, CLEMS, GH, NMCR as *A. hyemalis*).

**Agrostis stolonifera* L. var. *compacta* Hartm., Creeping bent-grass. Frequent to Occasional, Tidal marshes, Stable. *7442* (srh, TAES, VT); *21698* (CLEMS, GH, NMCR, NY, TAES, USF).

**Agrostis stolonifera* L. var. *stolonifera*, Creeping bent-grass. Occasional, Disturbed land, Stable. *7422* (srh, LG, TAES, VT); *9325* (TAES).

**Agrostis tenuis* Sibth., Rhode Island bent-grass. Frequent, Disturbed land, Stable. *7414* (MARY, TAES); *7416* (TAES, VT); *7418* (TAES, VT); *7425* (srh, TAES, VT); *7427* (srh, TAES).

Ammophila breviligulata Fern., Beachgrass. Frequent, Coastal beaches and dunes, Stable. *8719* (MARY, VT); *8741* (srh, MARY, VT).

Andropogon gerardii Vitman, Turkey-foot grass; Big bluestem. Occasional to Frequent, Disturbed land, Stable. *8742* (MARY, MO, VT); *9384* (srh, MARY, NY, TAES, VT).

**Anthoxanthum odoratum* L., Sweet vernal grass. Frequent, Disturbed land, Stable. *7420* (srh, TAES); *7430* (MARY).

**Avena sativa* L., Oats. Scarce, Disturbed land, Stable. *1160* (VT); *21650* (srh, CLEMS).

**Bromus tectorum* L., Cheatgrass. Occasional, Disturbed land, Stable. *21619* (srh, CLEMS, GH, NMCR, NY, NYS, TAES, USF).

Calamagrostis canadensis (Michx.) Beauv., Bluejoint grass. Infrequent, Tidal marshes, Freshwater marshes, Stable. *694* (VT); *21702* (srh, CLEMS, GH, NMCR).

**Dactylis glomerata* L., Orchard grass. Occasional to Frequent, Disturbed land, Stable. *7426* (srh).

Danthonia spicata (L.) Beauv., Poverty grass. Infrequent, Disturbed land, Oak forest, Stable. *21653* (srh, CLEMS).

**Digitaria sanguinalis* (L.) Scop., Crabgrass. Occasional, Disturbed land, Stable. *21723* (srh, CLEMS).

Distichlis spicata (L.) Greene, Spike grass. Frequent, Tidal marshes, Stable. *8720*

(srh, MARY, MO, NY, TAES, VT); *9429* (MARY, MO, TAES, VT); *13221* (GH, MARY, MO, NY, TAES, VT).

Echinochloa muricata (Beauv.) Fern. var. *microstachya* Wieg., Barnyard grass. Occasional, Disturbed land, Stable. *21649* (CLEMS); *22477* (srh, CLEMS, GH, NY, MO, TAES, USCH, WVA, USF).

**Eleusine indica* (L.) Gaertn., Goosegrass. Scarce, Disturbed land, Stable. *21635* (srh).

Elymus virginicus L. Virginia wild-rye. Frequent, Tidal marshes, Coastal beaches and dunes, Disturbed land, Stable. *693* (VT); *9428* (GH, MARY, MO, NY, TAES, VT); *13216* (srh, GH, MARY, NY, TAES, VT).

**Elytrigia repens* (L.) Nevski [*Agropyron repens* (L.) Beauv.], Quack-grass. Abundant to Frequent, Disturbed land, Coastal beaches and dunes, Stable. *7424* (MARY, TAES); *7441* (srh, TAES, VT).

Eragrostis pectinacea (Michx.) Nees, Love-grass. Infrequent, Disturbed land, Stable. *9397* (srh, MARY, NY, TAES, VT).

Eragrostis spectabilis (Pursh) Steud., Tumble-grass. Occasional, Disturbed land, Stable. *9396* (srh, TAES, VT).

**Festuca pratensis* Hudson [*F. elatior* L.], Meadow fescue. Occasional, Disturbed land, Stable. *21603* (TAES).

**Festuca rubra* L., Red fescue. Frequent, Disturbed land, Stable. *10092* (srh, GH, MARY, MO, NY, TAES, VT).

Hierochloe odorata (L.) Beauv. [*Anthoxanthum nitens* (Weber) Schouten & Veldkamp], Sweet grass. Occasional, Tidal marshes, Stable. *21696* (srh, CLEMS, GH, NMCR, NY); *23086* (srh, CLEMS, GH, MO, NY, USF).

**Holcus lanatus* L., Velvet-grass. Frequent, Disturbed land, Stable. *7421* (srh, TAES, VT); *21600* (CLEMS, GH, LG, NMCR, NY, USF).

Leersia oryzoides (L.) Sw., Cutgrass. Infrequent, Freshwater marshes, Stable. *9372* (MO).

**Lolium perenne* L. [*L. multiflorum* Lam.], Rye-grass. Occasional, Disturbed land, Stable. *7435* (srh, TAES).

Panicum capillare L., Panic-grass. Occasional, Coastal beaches and dunes, Stable. *8721* (srh, MARY, NY, TAES, VT).

Panicum clandestinum L., Deer-tongue grass. Frequent, Oak forest, Disturbed land, Stable. *1162* (NY, VT); *7415* (srh).

Panicum dichotomiflorum Michx., Panic-grass. Occasional, Disturbed land, Stable. *24181* (CLEMS, GH, MO, NY, TAES).

Panicum lanuginosum Ell. var. *fasciculatum* (Torr.) Fern., Panic-grass. Occasional, Coastal beaches and dunes, Stable. *9438* (srh, NY, VT).

Panicum meridionale Ashe, Panic-grass. Occasional, Disturbed land, Stable. *1163* (NY, VT); *21634* (srh, CLEMS, GH, MO, NY, TAES, USAM, USF).

**Panicum miliaceum* L., Proso millet. Scarce, Disturbed land, Waif. *22515* (srh, CLEMS, NY).

Panicum rigidulum Nees [*P. agrostoides* Spreng.], Panic-grass. Infrequent, Disturbed land, Stable. *22480* (srh, CLEMS, GH, NY, TAES, USF).

Panicum virgatum L., Switch grass. Frequent, Disturbed land, Stable. *8743* (srh, MARY, NY, VT).

Phalaris arundinacea L., Reed canary-grass. Frequent, Freshwater marshes, Disturbed land, Stable. *21706* (srh, CLEMS, GH, LG, NMCR, NY).

**Phleum pratense* L., Timothy. Frequent to Occasional, Disturbed land, Stable. *7423* (srh, TAES).

Phragmites australis (Cav.) Trin. ex Steud., Common reed. Frequent, Freshwater marshes, Tidal marshes, Increasing. *8744* (srh, MARY, VT); *21731* (CLEMS, NMCR).

Poa alsodes A. Gray, Woodland bluegrass. Infrequent, Oak forest, Stable. *21716* (srh).

**Poa annua* L., Annual bluegrass. Infrequent, Disturbed land, Stable. *21617* (srh, CLEMS, GH, NMCR); *23124* (CLEMS, GH, ILLS, MO, NY, SMU, TAES, TEX, USF).

**Poa compressa* L., Canada bluegrass. Frequent, Disturbed land, Stable. *7417* (srh, CHAPA, LG, TAES, VT); *7428* (TAES, VT).

Poa palustris L., Swamp bluegrass. Infrequent, Oak forest, Disturbed land, Stable. NW quadrant of Latimer Point, 20 Jul 1990, *21717* (srh, CLEMS, LG, NMCR, NY, USF). First record for southeastern Connecticut.

**Poa pratensis* L., Kentucky bluegrass. Frequent, Disturbed land, Stable. *21607* (srh, CLEMS, NMCR).

Schizachyrium scoparium (Michx.) Nash, Little bluestem. Frequent, Disturbed land, Stable. *9385* (srh, MARY, NY, TAES, VT).

**Secale cereale* L., Rye. Infrequent to Scarce, Disturbed land, Stable. *21765* (srh, CLEMS, NMCR).

**Setaria glauca* (L.) Beauv., Yellow foxtail. Occasional, Disturbed land, Stable. *9403* (srh, MARY, NY, TAES, VT).

**Setaria viridis* (L.) Beauv., Green foxtail. Occasional, Disturbed land, Stable. S side US Rt. 1 near VFW post opposite Long Wharf Road near old landfill, 14 Aug 1980, *9393* (srh, NY, TAES, VT). Not in Tucker (1995).

Sorghastrum nutans (L.) Nash, Indian-grass. Occasional to Infrequent, Disturbed land, Stable. *8745* (srh, MARY, NY, VT).

Spartina alterniflora Loisel., Cord-grass. Frequent, Tidal marshes, Stable. *695* (VT); *696* (NCU, VT); *8722* (srh, MARY, VT); *9439* (GH, MARY, MO, NY, SMU, TAES, VT); *13219* (CLEMS, GH, MARY, MO, NY, TAES, VT).

Spartina cynosuroides (L.) Roth, Tall cordgrass. Occasional, Disturbed land, Freshwater marshes, Stable. *9328* (srh, MARY, TAES, VT).

Spartina patens (Ait.) Muhl., Marsh-hay. Abundant, Tidal marshes, Stable. *697* (NCU, VT); *8723* (srh, MARY, NY, TAES, VT); *9432* (MARY, MO, NY, TAES, VT).

Spartina pectinata Link, Freshwater cordgrass. Infrequent, Tidal marshes, Stable. *8746* (srh, MARY).

Triplasis purpurea (Walt.) Chapm., Purple sand grass. Scarce, Coastal beaches and dunes, Stable. *8747* (srh, MARY).

Vulpia octoflora (Walt.) Rydb., Six-weeks grass. Occasional, Disturbed land, Coastal beaches and dunes, Stable. *7419* (srh, TAES); *7429* (MARY, TAES); *7443* (TAES, VT); *7444* (CHAPA, TAES).

POTAMOGETONACEAE

Potamogeton oakesianus Robbins, Pondweed. Scarce, Freshwater marshes, Stable. *21763* (srh, CLEMS, NY, UNA).

RUPPIACEAE

Ruppia maritima L., Widgeongrass. Infrequent, Estuaries, Stable. *20806* (srh).

SMILACACEAE

Smilax glauca Walter, Cat-brier. Frequent, Oak forest, Stable. *330* (VT); *9426* (srh, MARY, MO, NY, TAES, VT).

Smilax rotundifolia L., Bull-brier. Frequent, Oak forest, Stable. *1245* (NY); *21663* (srh, CLEMS, GH, NYS).

SPARGANIACEAE

Sparganium americanum Nutt., Bur-reed. Scarce, Freshwater marshes, Stable. *21762* (CLEMS, NY).

TYPHACEAE

Typha latifolia L., Common cat-tail. Occasional, Freshwater marshes, Stable. *21730* (CLEMS, NYS).

ZOSTERACEAE

Zostera marina L. var. *stenophylla* Aschers. & Graeb., Eel-grass. Abundant, Estuaries, Stable. Major fluctuations have been seen in the populations, from massive decline in the early 1970s to current abundance. *9334* (srh, MARY, MO, NY, TAES, VT).

MAGNOLIOPSIDA (Dicotyledons)

ACERACEAE

**Acer platanoides* L., Norway maple. Infrequent, Disturbed land, Increasing. *10071* (srh, GH, MARY, MO, NY, TAES, VT); *21759* (CLEMS, NY); *23095* (srh, CLEMS, GH, ILLS, MO, NY, SMU, TAES, TEX, USF); *23101* (srh).

**Acer pseudoplatanus* L., Sycamore-maple. Scarce, Disturbed land, Increasing. *10243* (srh, GH, MARY, NY, TAES, VT).

Acer rubrum L., Red maple. Frequent to Occasional, Oak forest, Shrub swamps, Stable. *9106* (srh, MARY); *23099* (CLEMS, NY).

AMARANTHACEAE

**Amaranthus albus* L., Tumbleweed. Infrequent, Disturbed land, Coastal beaches and dunes, Stable. *21655* (srh, CLEMS, NYS).

**Amaranthus retroflexus* L., Pigweed. Occasional, Disturbed land, Stable. *21636* (srh, CLEMS, NYS).

ANACARDIACEAE

Rhus copallina L., Winged sumac. Occasional, Disturbed land, Oak forest margin, Stable. *9349* (srh, MARY, NY, TAES, VT).

Rhus glabra L., Smooth sumac. Occasional, Disturbed land, Stable. *21724* (srh, CLEMS, NYS).

Rhus typhina L., Staghorn sumac. Occasional to Infrequent, Disturbed land, Stable. *21694* (srh, CLEMS, GH, LG, NY, NYS).

Toxicodendron radicans (L.) Kuntze, Poison ivy. Abundant, Oak forest, Coastal beaches and dunes, Shrub swamps, Disturbed land, Stable. As common on the

islands (often forming dense thickets) as on the mainland. *21720* (srh, CLEMS, GH, LG, NY, NYS).

APIACEAE

Angelica lucida (L.) Fern. [*Coelopleurum lucidum* (L.) Fern.], Seacoast angelica. Scarce, Tidal marshes (just above reach of high tide), Stable. Included here based on a report in the Connecticut Natural Diversity Data Base, according to which it was last observed in 1978 on Dodges Island. I have not seen a specimen. This species is listed as endangered in Connecticut.

Cicuta maculata L., Water-hemlock. Infrequent, Tidal marshes, Freshwater marshes, Stable. *9317* (srh, NY, VT).

Heracleum lanatum Michx., Cow-parsnip. Infrequent to Frequent locally, Tidal marshes, Disturbed land, Stable. *326* (VT); *10242* (srh, GH, MARY, MO, NY, TAES, VT).

Ligusticum scothicum L., Scotch lovage. Infrequent, Coastal beaches and dunes (just above reach of high tide), stable. Approaching its southernmost range limit. SE quadrant of Latimer Point near main beach, 9 Sep 1979, *8734* (srh, MARY, NY, VT); Dodges Island, 16 Aug 1980, *9440* (NY, TAES, VT). Listed as a plant of Special Concern in Connecticut.

Ptilimnium capillaceum (Michx.) Raf., Mock bishop-weed. Infrequent, Disturbed land, Freshwater marshes, Stable. *9377* (srh, GH, MARY, MO, NY, SMU, TAES, VT).

Sium suave Walt., Water-parsnip. Infrequent, Freshwater marshes, Stable. *21755* (CLEMS).

APOCYNACEAE

Apocynum androsaemifolium L., Spreading dogbane. Occasional, Disturbed land, Stable. *9321* (srh, NY, TAES, VT); *21795* (srh).

Apocynum cannabinum L., Hemp-dogbane. Infrequent, Disturbed land, Stable. *21692* (srh, CLEMS, GH, LG, NY, NYS).

AQUIFOLIACEAE

Ilex verticillata (L.) A. Gray, Black alder. Infrequent, Shrub swamps, Disturbed land, Stable. *11833* (VT); *21703* (CLEMS, GH, LG, MOR, NY, TAES, USF).

ARALIACEAE

Aralia nudicaulis L., Wild sarsaparilla. Infrequent, Oak forest, Stable. *10096* (srh, GH, MARY, NY, TAES, VT).

ASCLEPIADACEAE

Asclepias incarnata L., Swamp milkweed. Occasional, Freshwater marshes, Stable. *9367* (srh, MARY, NY, VT); *21741* (CLEMS, GH, LG, NY, USF).

Asclepias syriaca L., Common milkweed. Occasional, Disturbed land, Stable. *21709* (srh, CLEMS, NYS).

**Cynanchum nigrum* (L.) Pers., Black swallow-wort. Infrequent, Disturbed land, Stable. *9399* (srh, MARY); *10247* (srh, BH, GH, ILL, MARY, MO, NY, RSA, SMU, TAES, VT).

ASTERACEAE

**Achillea millefolium* L., Yarrow. Occasional, Disturbed land, Stable. *8724* (srh, MARY, VT); *21612* (CLEMS, GH, NY, NYS).

Ambrosia artemisiifolia L., Common ragweed. Frequent, Disturbed land, Coastal beaches and dunes, Stable. *944* (NY, VT); *8748* (srh, MARY).

**Anthemis cotula* L., Mayweed. Infrequent, Disturbed land, Declining. *9395* (srh, MARY, MO, NY, TAES, VT).

**Arctium lappa* L., Great burdock. Occasional to Infrequent, Disturbed land, Stable. *23110* (CLEMS, NY); *24184* (srh, CLEMS).

**Artemisia stelleriana* Besser, Beach wormwood. Scarce, Coastal beaches and dunes, Declining. Has not been seen here since 1980. Beach between Latimer and Lords Point, 3 Jul 1978, *7436* (srh, VT).

**Artemisia vulgaris* L., Mugwort. Scarce, Disturbed land, Increasing. *21789* (CLEMS, MO); *23118* (CLEMS, NY).

Aster divaricatus L., White woods aster. Occasional, Oak forest, Stable. *21783* (CLEMS, GH).

Aster dumosus L., Bushy aster. Occasional, Oak forest, Stable. *22474* (srh, CLEMS).

Aster lanceolatus Willd. var. *simplex* (Willd.) A. G. Jones, Tall white aster. Frequent, Disturbed land, Stable. *10799* (srh, ILL, MARY, MO, NY, TAES, VT).

Aster tenuifolius L., Large salt marsh aster. Occasional, Tidal marshes, Stable. *953* (VT).

Aster umbellatus Mill., Flat-top aster. Occasional, Disturbed land, Freshwater marshes, Stable. *9387* (srh, MARY, NY, TAES, VT).

Baccharis halimifolia L., Sea-myrtle. Occasional, Coastal beaches and dunes, Disturbed land, Stable. *10801* (srh, GA, GH, ILL, MARY, MO, NY, TAES, VT).

**Centaurea maculosa* Lam., Bushy knapweed. Occasional, Disturbed land, Increasing. *21771* (srh, CLEMS, GH, NY, NYS, TAES, USF).

**Chrysanthemum leucanthemum* L. [*Leucanthemum vulgare* Lam.], Daisy. Occasional, Disturbed land, Stable. *21700* (srh).

**Cichorium intybus* L., Chicory. Occasional, Disturbed land, Stable. *21627* (srh, CLEMS, GH, NYS).

**Cirsium vulgare* (Savi) Tenore, Bull thistle. Occasional, Disturbed land, Stable. *21792* (CLEMS, MO).

Conyza canadensis (L.) Cronq., Horseweed. Frequent, Disturbed land, Stable. *936* (NY, VT); *9406* (srh, MARY, NY, TAES, VT).

Erechtites hieraciifolia (L.) Raf. ex DC., Fireweed. Frequent, Disturbed land, Coastal beaches and dunes, Stable. *8749* (srh, MARY); *9441* (MARY, MO, NY, TAES, VT).

Erigeron annuus (L.) Pers., Daisy-fleabane. Scarce, Disturbed land, Stable. *21687* (srh, CLEMS).

Eupatorium dubium Willd. ex Poir., Joe-pye-weed. Occasional, Shrub swamps, Stable. *9355* (srh, MARY, NY, VT).

Eupatorium perfoliatum L., Boneset. Occasional, Shrub swamps, Freshwater marshes, Stable. *9379* (srh, MARY, NY, TAES, VT); *22478* (srh, CLEMS, GH, MO, NY, TAES, USCH, USF).

Euthamia graminifolia (L.) Nutt., Flat-topped goldenrod. Occasional, Disturbed land, Stable. *9352* (srh, MARY, NY, TAES, VT); *10800* (GH, MARY, MO, NY, SMU, TAES, VT); *21749* (NY).

**Galinsoga parviflora* Cav., Quickweed. Occasional, Disturbed land, Stable. *21646* (srh).

Gnaphalium obtusifolium L., Cudweed. Infrequent, Disturbed land, Stable. *22513* (srh, CLEMS).

Gnaphalium uliginosum L., Cudweed. Scarce, Disturbed land, Stable. *21797* (srh, CLEMS).

**Hieracium caespitosum* Dum. [*H. pratense* Tausch], Common hawkweed. Infrequent, Disturbed land, Stable. *10073* (CLEMS, MARY).

**Hypochoeris radicata* L., Cat's-ears. Infrequent, Disturbed land, Increasing. It was first seen in the study area in 1980. S side US Rt. 1 near VFW post opposite Long Wharf Road near old landfill, 14 Aug 1980, *9390* (CLEMS, MARY, NY, VT). This is a South American plant which is an aggressive weed in the southeastern U.S. but has recently spread north and is increasing its range.

Iva frutescens L. subsp. *oraria* (Bartl.) R.C. Jackson, High-tide bush. Frequent, Tidal marshes, Stable. *8750* (CLEMS, MARY); *9430* (MARY, MO, NY, TAES, VT); *13215* (srh, GH, MARY, MO, NY, TAES, VT).

Lactuca canadensis L. var. *longifolia* (Michx.) Farw., Wild lettuce. Occasional, Disturbed land, Shrub swamps, Stable. *9348* (srh, GH, MARY, MO, NY, TAES, VT).

Lactuca canadensis L. var. *obovata* Wieg., Wild lettuce. Occasional, Disturbed land, Shrub swamps, Stable. *9347* (srh, MARY, NY, VT).

**Lactuca serriola* L., Prickly lettuce. Occasional, Disturbed land, Increasing. *24183* (srh, CLEMS, GH, NY).

**Matricaria matricarioides* (Less.) Porter, Pineapple-weed. Infrequent, Disturbed land, Stable. *21624* (srh, CLEMS, GH, NY, NYS).

Prenanthes trifoliolata (Cass.) Fern., Rattlesnake-root. Infrequent, Oak forest, Stable. *23108* (NY).

**Rudbeckia hirta* L. var. *pulcherrima* Farw., Black-eyed Susan. Infrequent, Disturbed land, Stable. *9318* (srh, NY, VT); *21745* (CLEMS, GH).

Solidago juncea Ait., Early goldenrod. Frequent, Disturbed land, Stable. *9407* (srh, MARY, NY, TAES, VT); *21737* (CLEMS, NY, NYS).

Solidago sempervirens L., Seaside goldenrod. Frequent, Tidal marshes, Coastal beaches and dunes, Stable. *9442* (srh, VT).

**Sonchus arvensis* L., Sow-thistle. Infrequent, Disturbed land, Increasing. First seen in the study area in 1979. SW quadrant of Latimer Point near boat ramp, 9 Sep 1979, *8735* (srh, MARY, NY, TAES, VT); spread to Dodges Island, 16 Aug 1980, *9443* (MARY, MO, NY, TAES, VT).

**Sonchus oleraceus* L., Milk-thistle. Occasional, Disturbed land, Stable. *21631* (srh, CLEMS, CTES, GH, LG, NY, NYS, USF).

**Taraxacum officinale* Weber ex Wiggers, Common dandelion. Occasional, Disturbed land, Stable. *21625* (srh, CLEMS, NYS).

BALSAMINACEAE

Impatiens capensis Meerb., Touch-me-not. Occasional, Disturbed land, Freshwater marshes, Stable. *8736* (srh, MARY, NY, TAES, VT).

BERBERIDACEAE

**Berberis thunbergii* DC., Japanese barberry. Occasional, Disturbed land, Oak forest, Increasing. *23092* (srh, CLEMS, GH, NY).

**Berberis thunbergii* DC. var. *atropurpurea* Chenault, Purple-leaf Japanese barberry. Infrequent to Scarce, Disturbed land, Increasing. Planted and some escaped at SE quadrant of Latimer Point, 24 Jul 1990, *21791* (srh, CLEMS, GH, LG, NY, USF).

**Berberis vulgaris* L., European barberry. Scarce, Disturbed land, Declining. May have been eliminated from Point by clearing of shrubs near main beach in late 1980s. Thicket, SW quadrant of Latimer Point near main beach, 24 May 1980, *9109* (srh, MARY, NY, TAES, VT).

BETULACEAE

Betula populifolia Marsh., Gray birch. Occasional, Disturbed land, Declining. Succession and increased herbicide treatments along the RR right-of-way have caused a decline in the local population of this species. *9111* (srh, MARY); *10079* (GA, GH, MARY, MO, NY, TAES, VT); *23083* (CLEMS, GH, NY, USF).

Corylus americana Walt., Hazelnut. Scarce, Oak forest, Stable. *9310* (srh, NY, VT).

BRASSICACEAE

**Arabidopsis thaliana* (L.) Heynh., Mouse-ear cress. Scarce, Disturbed land, Stable. *23111* (srh, CLEMS, GH, NY).

**Barbarea vulgaris* R.Br., Common wintercress. Frequent, Disturbed land, Stable. *10064* (srh, BAA, GH, MARY, MO, NY, SMU, TAES, VT).

Cakile edentula (Bigel.) Hook., Sea-rocket. Occasional, Coastal beaches and dunes, Stable. *1153* (VT); *7439* (srh).

**Capsella bursa-pastoris* (L.) Medikus, Shepherd's-purse. Occasional, Disturbed land, Stable. *21620* (CLEMS, CTES, GH, NY, NYS, TAES, USF).

**Hesperis matronalis* L., Dame's rocket. Infrequent, Disturbed land, Stable. *10065* (srh, GH, MARY, NY, TAES, VT).

Lepidium virginicum L., Peppergrass. Frequent, Disturbed land, Coastal beaches and dunes, Stable. *8725* (srh); *21610* (CLEMS, GH, NY, NYS).

**Lunaria annua* L., Money plant. Scarce, Disturbed land, Stable. Garden escape, SE quadrant of Latimer Point at roadsides, 13 May 1992, *23114* (NY).

**Raphanus raphanistrum* L., Wild radish. Frequent, Disturbed land, Coastal beaches and dunes, Stable. *1154* (NY, VT); *7438* (CLEMS, VT); *8726* (srh, MARY); *10244* (GH, MARY, MO, NY, TAES, VT).

**Sisymbrium officinale* (L.) Scop., Tower-mustard. Scarce, Disturbed land, Stable. *21689* (CLEMS, NYS).

**Thlaspi arvense* L., Penny-cress. Infrequent, Disturbed land, Stable. *10245* (MARY, NY, TAES, VT); *21701* (srh).

BUXACEAE

**Pachysandra terminalis* Sieb. & Zucc., Pachysandra. Infrequent, Disturbed land, Stable. Established in vicinity of residences, SW quadrant of Latimer Point, 13 May 1992, *23102* (CLEMS, GH, NY).

CAMPANULACEAE

Lobelia inflata L., Indian tobacco. Infrequent, Disturbed land at Oak forest margins, Stable. *22475* (CLEMS, NY).

CAPRIFOLIACEAE

**Lonicera japonica* Thunb., Japanese honeysuckle. Frequent, Disturbed land, Oak forest, Increasing. Distribution of this prolific, pernicious, weedy vine seems to be limited here only by pavement, salt water and dense shade. *21613* (CLEMS, GH, NYS).

**Lonicera morrowii* A. Gray, Fly honeysuckle. Frequent, Oak forest, Disturbed land, Increasing. Though this common weedy shrub is damaging to the native plant associations, it is encouraged in local residence yards on the Point. *9113* (srh, MARY, NY, TAES, VT); *21790* (CLEMS, CTES, GH, LG, MO, NY, TAES, USF).

Sambucus canadensis L., Common elderberry. Occasional, Shrub swamps, Stable. *9354* (srh, MARY, NY, TAES, VT).

Viburnum recognitum Fern. [*V. dentatum* L. var. *lucidum* Ait.], Arrow-wood. Occasional, Oak forest, Shrub swamps, Stable. *9350* (srh, MARY, MO, NY, TAES, VT); *21658* (CLEMS, GH, NY, NYS).

CARYOPHYLLACEAE

**Cerastium fontanum* Baumg. emend. Jalas subsp. *vulgare* (Hartman) Greuter & Burdet [*C. vulgatum* L.], Mouse-eared chickweed. Occasional, Disturbed land, Stable. *21609* (CLEMS, GH, NY, MICH, USF); *23126* (ILLS, MICH).

**Dianthus armeria* L., Deptford pink. Occasional, Disturbed land, Stable. *21601* (srh, CLEMS, MICH).

Honckenya peploides (L.) Ehrh. subsp. *robusta* (Fern.) J. Hultén, Seabeach sandwort. Infrequent, Coastal beaches and dunes, Declining. Beach between Latimer and Lords Points, 30 Jun 1973, *1152* (VT); same locality, 3 Jul 1978, *7440* (srh, VT); same locality, 5 Jun 1983, *12726* (srh, GH, MARY, MO, NY, TAES, VT). This species is listed as a Species of Special Concern in Connecticut.

Moehringia lateriflora (L.) Fenzl [*Arenaria lateriflora* L.], Grove sandwort. Occasional, Oak forest margins, Shrub swamps, Stable. *9118* (srh, MARY, NY, VT); *10083* (GH, MARY, NY, TAES, VT); *21705* (srh, CLEMS, GH, LG, NY, USF).

Sagina decumbens (Ell.) Torr. & A. Gray, Pearlwort. Infrequent, Disturbed land, Stable. *10088* (srh, GH, MARY, NY, TAES, VT).

**Sagina procumbens* L., Pearlwort. Infrequent, Disturbed land, Stable. *22517* (srh, CLEMS).

**Saponaria officinalis* L., Bouncing-bet. Occasional to Frequent, Coastal beaches and dunes, Disturbed land, Stable. *8751* (srh, MARY).

**Scleranthus annuus* L., Knawel. Infrequent, Disturbed land, Stable. *21632* (srh, CLEMS, MICH).

**Silene armeria* L., Sweet William. Infrequent, Disturbed land, Waif. *9400* (MARY, VT).

**Silene latifolia* Poir. subsp. *alba* (Mill.) Greuter & Burdet [*Lychnis alba* Mill.], White campion. Occasional, Disturbed land, Stable. *1166* (VT); *21642* (srh, CLEMS, GH, MICH, NY).

**Spergularia marina* (L.) Griseb., Sand-spurrey. Occasional to Frequent, Tidal marshes, Disturbed land, Increasing. *8727* (srh, MARY, VT); *9435* (MARY, MO, NY, TAES, VT); *21648* (CLEMS, GH, MICH, MO, NY, TAES, USF); *21793* (srh, CLEMS, GH, MICH, NY, TAES, USF).

**Stellaria graminea* L., Grass-leaved chickweed. Occasional to Infrequent, Disturbed land, Stable. *10089* (srh, GH, MARY, NY, TAES, VT); *24182* (srh).

**Stellaria media* (L.) Villars, Common chickweed. Occasional, Disturbed land, Stable. *21654* (srh, CLEMS, GH, MICH, NY).

CELASTRACEAE

**Celastrus orbiculatus* Thunb., Bittersweet. Frequent, Disturbed land, Coastal beaches and dunes, Stable. *1156* (NY, VT); *8752* (srh, MARY); *10087* (GH, MARY, NY, TAES, VT).

**Euonymus alatus* (Thunb.) Sieb., Winged spindle-tree. Infrequent, Disturbed land, Oak forest, Increasing. *10063* (srh, GH, MARY, MO, NY, TAES, VT); *23109* (CLEMS, NY, USF).

CHENOPODIACEAE

Atriplex patula L. var. *hastata* (L.) A. Gray, Orach. Frequent, Coastal beaches and dunes, Stable. *798* (VT); *9444* (srh, MARY, MO, NY, TAES, VT); *10802* (srh, CTESN, GA, GH, MARY, MO, NY, TAES, VT), *10803* (NY, RSA, SMU, TAES, VT).

Chenopodium album L., Lamb's-quarters. Frequent, Coastal beaches and dunes, Disturbed land, Stable. *797* (VT); *8728* (MARY, NY, VT); *9401* (GH, MARY, MO, NY, TAES, VT); *17063* (srh, GH, MO, NY, SMU, TAES, VT).

Salicornia bigelovii Torr., Annual glasswort. Occasional, Tidal marshes, Stable. *9436* (srh, MARY, NY, TAES, VT).

Salicornia europaea L., Annual glasswort. Occasional, Tidal marshes, Stable. *13220* (srh, GH, MARY, MO, NY, TAES, VT).

Salicornia perennis Miller [*S. virginica* auth.], Perennial glasswort. Infrequent, Tidal marshes, Stable. *13222* (srh, GH, MARY, MO, NY, TAES, VT).

Salsola kali L., Saltwort. Infrequent, Coastal beaches and dunes, Stable. *799* (VT); *8729* (srh, MARY).

Suaeda linearis (Ell.) Moq., Sea-blite. Occasional, Tidal marshes, Coastal beaches and dunes, Stable. *948* (NY, VT); *8753* (srh, MARY, VT).

CISTACEAE

Helianthemum bicknellii Fern., Rockrose. Infrequent, Oak forest, Disturbed land, Stable. *1161* (VT); *9330* (srh, MARY, NY, TAES, VT); *9345* (srh, MARY, NY, TAES, VT).

CLETHRACEAE

Clethra alnifolia L. var. *alnifolia*, Sweet pepperbush. Frequent, Shrub swamps, Stable. In early August the air throughout the area is filled with the sweet aroma from these shrubs. *9351* (srh, MARY, NY, TAES, VT).

CONVOLVULACEAE

Calystegia sepium (L.) R.Br. subsp. *americana* (Sims) Brummitt, Wild morning-glory. Frequent, Disturbed land, Tidal marshes, Coastal beaches and dunes, Stable. *316* (VT); *8730* (srh, MARY, VT).

**Ipomoea purpurea* (L.) Roth., Common morning-glory. Infrequent, Disturbed land, Increasing. Cultivated and escaped in SE quadrant of Latimer Point near residences, 26 Sep 1981, *10797* (srh, MARY, NY, TAES, VT).

CORNACEAE

Cornus amomum Mill., Silky dogwood. Occasional to Infrequent, Disturbed land, Shrub swamps, Stable. *21760* (CLEMS, GH, NYS).

CUSCUTACEAE

Cuscuta pentagona Engelm. [*C. campestris* Yuncker], Dodder. Scarce, Disturbed land, Increasing. NE quadrant of Latimer Point at RR right-of-way, 5 Aug 1991, *22481* (srh, CLEMS, GH, MO, NY, TAES, USCH, USF); SW quadrant of Latimer Point near boat ramp, 7 Aug 1991, *22503* (srh, CLEMS, GH, NY, USF). First report for southeastern Connecticut.

ELAEAGNACEAE

**Elaeagnus umbellata* Thunb., Autumn olive. Occasional to Infrequent, Disturbed land, Increasing. While relatively infrequent in the 1960s and 1970s, this plant has spread very quickly in the 1980s and 1990s in the area. *10074* (GH, MARY, MO, NY, TAES, VT); *21747* (CLEMS, GH, NY, NYS); Latimer Point Road at RR crossing, first sighting on the point itself, 13 May 1992, *23094* (CLEMS, NY).

ERICACEAE

Gaylussacia baccata (Wang.) K. Koch, Huckleberry. Occasional, Oak forest, Stable. *9120* (srh, MARY, NY, TAES, VT); *21704* (CLEMS, GH, NY, TAES, USF).

Lyonia ligustrina (L.) DC. var. *ligustrina*, Maleberry. Infrequent, Shrub swamps, Disturbed land, Stable. *9389* (srh, MARY, NY, TAES, VT).

Rhododendron viscosum (L.) Torr., Swamp azalea. Infrequent, Shrub swamps, Stable. *21713* (srh, CLEMS, GH, NY, NYS).

Vaccinium corymbosum L., Highbush blueberry. Occasional, Oak forest, Shrub swamps, Stable. *9115* (MARY, NY, TAES, VT); *21660* (srh, BAA, CLEMS, CTES, GH, NY, TAES, USF); *23097* (CLEMS, GH, ILLS, MO, NY, PE, TAES, TEX, USF).

Vaccinium fuscatum Ait. [*V. atrococcum* (A. Gray) Heller], Highbush blueberry. Frequent, Oak forest, Shrub swamps, Stable. *9116* (MARY, NY, TAES, VT); *9314* (MARY, NY, TAES, VT); *9315* (NY, TAES, VT).

EUPHORBIACEAE

Acalypha gracilens A. Gray, Three-seeded mercury. Scarce, Disturbed land, Stable. *21798* (srh, CLEMS, GH, NY).

Euphorbia maculata L. [*Chamaesyce maculata* (L.) Small], Creeping spurge. Occasional, Disturbed land, Stable. *9427* (GH, MARY, MO, NY, SMU, TAES, VT).

Euphorbia polygonifolia L. [*Chamaesyce polygonifolia* (L.) Small], Beach spurge. Infrequent, Coastal beaches and dunes, Stable. *8739* (srh, MARY, NY, TAES, VT).

FABACEAE

Amorpha fruticosa L., Indigo bush. Infrequent, Coastal beaches and dunes (above highest tide mark), Stable. *9447* (srh, MARY, NY, TAES, VT).

Amphicarpaea bracteata (L.) Fern., Hog-peanut. Occasional, Oak forest margins, Stable. *21794* (srh, CLEMS, ISC).

Apios americana Medikus, Ground-nut. Occasional, Oak forest margins, Shrub swamps, Stable. *9356* (srh, GH, MARY, MO, NY, SMU, TAES, VT).

Baptisia tinctoria (L.) R.Br. ex Ait. f. var. *crebra* Fern., Indigo-bush. Occasional, Oak forest, Disturbed land, Stable. *9346* (srh, MARY, MO, NY, TAES, VT); *21691* (CLEMS, GH, NY, NYS); *22487* (CLEMS, GH, MO, NY, TAES, USCH, WVA, USF).

Cassia nictitans L. [*Chamaecrista nictitans* (L.) Moench], Wild sensitive-plant. Occasional, Disturbed land, Stable. *9402* (srh, MARY, NY, VT).

**Coronilla varia* L., Crown vetch. Infrequent, Disturbed land, Stable. *21690* (srh, CLEMS).

Lathyrus japonicus Willd. [*Lathyrus maritimus* (L.) Bigel.], Beach pea. Frequent, Coastal beaches and dunes, Stable. *323* (NY, VT); *7437* (srh, VT); *10066* (srh, MARY, NY, VT).

**Lathyrus latifolius* L., Sweet pea. Infrequent, Disturbed land, Stable. *24180* (srh).

Lathyrus palustris L., Marsh vetch. Infrequent, Tidal marshes (above high tide mark), Stable. *9320* (srh).

Lespedeza hirta (L.) Hornem., Lespedeza. Occasional, Disturbed land, Stable. *22483* (srh, CLEMS, GH, NY, TAES, USF).

**Lotus corniculatus* L., Bird's-foot trefoil. Infrequent, Disturbed land, Stable. *21727* (srh, CLEMS, NYS).

**Medicago lupulina* L., Hop-clover. Infrequent, Disturbed land, Stable. *21626* (CLEMS, ISC, USF).

**Melilotus alba* Medikus, White sweet clover. Infrequent, Disturbed land, Stable. *22511* (srh, CLEMS, NY).

Strophostyles helvula (L.) Ell., Pink wild bean. Infrequent, Coastal beaches and dunes, Disturbed land, Stable. *801* (VT); *21751* (srh, CLEMS).

**Trifolium arvense* L., Rabbit's-foot clover. Infrequent, Disturbed land, Stable. *21621* (srh, CLEMS, ISC).

**Trifolium aureum* Pollich [*T. agrarium* L., *nom. ambig.*], Yellow hop clover. Infrequent, Disturbed land, Stable. *21748* (CLEMS, GH, ISC, NY, USF); *24185* (srh).

**Trifolium hybridum* L., Alsike clover. Infrequent, Disturbed land, Stable. *22504* (srh, CLEMS).

**Trifolium pratense* L., Red clover. Occasional, Disturbed land, Stable. *21638* (srh, CLEMS, GH, ISC).

**Trifolium repens* L., White clover. Occasional, Disturbed land, Stable. *21608* (srh, CLEMS, GH, ISC, LG, NY).

**Vicia cracca* L., Tufted vetch. Infrequent, Disturbed land, Stable. *21736* (CLEMS, GH, LG, NY, NYS).

FAGACEAE

Quercus alba L., White oak. Frequent, Oak forest, Stable. *938* (VT); *21662* (CLEMS, GH, NYS).

Quercus bicolor Willd., Swamp white oak. Infrequent, Shrub swamps, Declining. Adversely affected by gypsy moth damage in the early-mid 1980s. *10080* (srh, GH, MARY, MO, NY, TAES, VT); *19804* (srh, CLEMS, MOR, NY, USF, VT).

Quercus rubra L., Red oak. Infrequent, Oak forest, Stable. *937* (VT).

Quercus velutina Lam., Black oak. Abundant, Oak forest, Stable. *9110* (MARY, VT); *9311* (MO, NY, VT); *9329* (srh, VT); *21708* (CLEMS, MOR, TAES); *21714* (CLEMS, MOR, NY).

GERANIACEAE

Geranium maculatum L., Wild geranium. Infrequent, Oak forest, Shrub swamps, Stable. *10098* (srh, GH, MARY, NY, TAES, VT).

HALORAGACEAE

Proserpinaca palustris L., Mermaid-weed. Infrequent, Freshwater marshes, Stable. *9326* (MARY, MO, VT); *9373* (srh, MARY, NY, TAES, VT).

HYPERICACEAE

Hypericum boreale (Britton) Bickn. [*H. mutilum* subsp. *boreale* (Britton) Gillett], Northern Saint John's-wort. Frequent, Freshwater marshes, Stable. *9364* (srh, GH, MARY, MO, NY, SMU, TAES, VT).

Hypericum gentianoides (L.) BSP., Orange grass. Infrequent, Disturbed land, Stable. *9382* (srh, GH, MARY, MO, NY, SMU, TAES, VT).

Hypericum majus (A. Gray) Britton, Greater Saint John's-wort. Infrequent, Disturbed land, Freshwater marshes, Stable. *22484* (srh); *22518* (srh, CLEMS, GH, NY, USF).

**Hypericum perforatum* L., Saint John's-wort. Occasional, Disturbed land, Stable. *9319* (srh, VT); *21645* (srh, CLEMS, GH, NY, NYS, TAES, USF).

Hypericum punctatum Lam., Saint John's-wort. Infrequent, Oak forest, Disturbed land, Stable. *21753* (srh, CLEMS); *21785* (srh).

Triadenum virginicum (L.) Raf., Pink Saint John's-wort. Frequent to Occasional, Freshwater marshes, Shrub swamps, Stable. *928* (VT); *9360* (srh, MARY, MO, NY, TAES, VT).

LAMIACEAE

**Ajuga reptans* L., Carpet-bugleweed. Occasional, Disturbed land, Stable. Lawn weed in residential area. *23120* (CLEMS, GH, MO, NY, USF).

**Glechoma hederacea* L., Ground-ivy. Occasional, Disturbed land, Stable. *23112* (srh, CLEMS).

**Lamium purpureum* L., Purple dead-nettle. Scarce, Disturbed land, Stable. *23113* (srh, CLEMS).

Lycopus americanus Muhl. ex Barton, Bugleweed. Occasional, Freshwater marshes, Disturbed land, Increasing. *21770* (srh, CLEMS, NY, NYS, TAES, USCH, USF); *22479* (CLEMS, GH, NY, TAES, USF).

Lycopus uniflorus Michx., Bugleweed. Infrequent, Freshwater marshes, Stable. *9368* (srh, MARY, NY, TAES, VT).

**Nepeta cataria* L., Catnip. Infrequent, Disturbed land, Stable. Dodges Island, 16 Aug 1980, *9445* (MARY, VT).

Pycnanthemum muticum (Michx.) Pers., Mountain-mint. Infrequent, Oak forest, Disturbed land, Stable. *21786* (srh, CLEMS).

**Stachys byzantina* C.Koch, Lamb's-ears. Scarce, Disturbed land, Waif. S side US Rt. 1 near VFW post opposite Long Wharf Road, 22 Jul 1990, *21768* (srh, CLEMS, NY). First report for southeastern Connecticut.

Teucrium canadense L. var. *canadense*, Seaside germander. Occasional, Disturbed land, Tidal marshes (above highest tide mark), Stable. *934* (VT); *9446* (srh, MARY, NY, VT); *21615* (srh, CLEMS, GH, NY, NYS).

Trichostema dichotomum L., Blue-curls. Infrequent, Disturbed land, Stable. *9344* (srh, MARY, NY, TAES, VT).

LAURACEAE

Sassafras albidum (Nutt.) Nees, Sassafras. Occasional, Oak forest margins, Stable. *9112* (NY, VT); *21643* (CLEMS, GH, NY, NYS); *23098* (srh, CLEMS, GH, ILLS, MO, NY, TAES, USF).

LINACEAE

Linum striatum Walt., Yellow wild flax. Infrequent, Disturbed land, Stable. *21740* (srh, CLEMS, NYS as *L. virginianum* L.).

LYTHRACEAE

**Lythrum salicaria* L., Purple loosestrife. Occasional to Infrequent, Disturbed land, Freshwater marshes, Stable. *9391* (srh, MARY, MO, NY, TAES, VT).

MALVACEAE

**Abutilon theophrasti* Medikus, Velvet-leaf. Scarce, Disturbed land, Waif. SW quadrant of Latimer Point in hedgerow, 8 Sep 1979, *8733* (srh, MARY, NY, TAES, VT).

Hibiscus palustris L., Wild hibiscus. Infrequent, Freshwater marshes, Declining. The showiest flower of Latimer Point; very attractive when in full flower in mid-August. The single pond where it grows is vulnerable to herbicide runoff from the RR right-of-way and to any road or RR construction nearby. One location, pond, NW quadrant of Latimer Point, 21 Aug 1972, *924* (NY, VT); same locality, 13 Aug 1980, *9366* (srh, GH, MARY, MO, NY, TAES, VT). Gleason and Cronquist (1991) and Tucker (1995) consider this a synonym of *Hibiscus moscheutos* L., but I prefer to recognize these northern all-pink forms as specifically distinct. In our area, they are never mixed with the white flowered *H. moscheutos*, which is more southern.

**Malva neglecta* Wallr., Common mallow. Scarce, Disturbed land, Stable. *21623* (srh).

MELASTOMATACEAE

Rhexia virginica L., Meadow-beauty. Infrequent, Disturbed land, Freshwater marshes, Stable. *21750* (CLEMS); *21796* (srh, CLEMS).

MOLLUGINACEAE

**Mollugo verticillata* L., Carpetweed. Frequent, Disturbed land, Stable. *9398* (srh, NY, TAES, VT); *21605* (CLEMS, GH, NY, NYS).

MONOTROPACEAE [within Ericaceae in Tucker 1995]

Monotropa uniflora L., Indian pipe. Scarce, Oak forest, Stable. *11855* (CLEMS); *21659* (srh, CLEMS).

MYRICACEAE

Comptonia peregrina (L.) Coult., Sweet-fern. Infrequent, Disturbed land, Oak forest margins, Stable. *22486* (srh, CLEMS, CM, GH, KANU, MO, NCU, NY, RSA, TAES, USCH, USF, UTC, WVA,); *23091* (srh, CLEMS, GH, MO, NY, SMU, TAES, TEX).

Myrica pensylvanica Loisel., Bayberry. Occasional, Disturbed land, Coastal beaches and dunes (above highest tide mark), Stable. *9117* (srh, MARY, NY, TAES, VT); *9380* (srh, MARY, NY, TAES, VT).

NYMPHAEACEAE

Nymphaea odorata Dryand. ex Aiton, Water-lily., Scarce, Freshwater marshes, Declining. In the pond with *Hibiscus*, NW quadrant of Latimer Point, 4 Jul 1980, *9327* (srh, MARY, VT).

NYSSACEAE

Nyssa sylvatica Marsh. var. *sylvatica*, Black gum. Occasional, Oak forest margins, Stable. *10100* (srh, CLEMS, GH, MARY, MO, NY, TAES, VT).

OLEACEAE

**Ligustrum vulgare* L., European privet. Infrequent, Disturbed land, Increasing. *9308* (srh); *23105* (srh, CLEMS).

ONAGRACEAE

Ludwigia alternifolia L., Seedbox. Infrequent, Freshwater marshes, Disturbed land, Stable. *21738* (srh, CLEMS).

Ludwigia palustris (L.) Ell., Water purslane. Infrequent, Freshwater marshes, Stable. *9374* (srh, MARY, NY, TAES, VT).

Oenothera biennis L., Evening-primrose. Frequent, Disturbed land, Coastal beaches and dunes, Stable. *8731* (srh, MARY); *9388* (MARY, NY, VT as *O. parviflora* L.).

OXALIDACEAE

Oxalis stricta L., Sour-grass. Occasional, Disturbed land, Stable. *21622* (srh).

PAPAVERACEAE

**Chelidonium majus* L., Celandine. Scarce, Disturbed land, Increasing. Seen but not vouchered in residential area in SE quadrant of Latimer Point, starting in 1982 (pers. obs.). It is frequent in nearby Mystic.

**Eschscholzia californica* Cham., California poppy. Scarce, Disturbed land, Waif. S side US Rt. 1 near VFW post opposite Long Wharf Road on landfill, 7 Aug 1991, *22512* (srh, CLEMS, NY). First report for southeastern Connecticut.

PHYTOLACCACEAE

Phytolacca americana L., Pokeweed. Occasional, Disturbed land, Stable. *9371* (srh, MARY, NY, TAES, VT).

PLANTAGINACEAE

**Plantago aristata* Michx., Buckhorn plantain. Infrequent, Disturbed land, Stable. *21688* (srh, CLEMS, GH, NYS).

**Plantago lanceolata* L., English plantain. Occasional, Disturbed land, Stable. *11806* (srh).

**Plantago major* L., Common plantain. Occasional, Disturbed land, Stable. *21599* (srh, CLEMS, GH, NY, NYS, TAES, USF).

Plantago maritima L., subsp. *juncoides* (Lam.) Hultén, Seaside plantain. Infrequent, Tidal marshes, Declining. I have seen little of this in recent years. NE quadrant of Latimer Point, 28 Aug 1983, *13214* (srh, GH, MARY, MO, NY, TAES, VT).

PLUMBAGINACEAE

Limonium carolinianum (Walt.) Britton, Sea lavender. Occasional, Tidal marshes, Stable. *9431* (srh, CLEMS, MARY, MO, NY, TAES, VT); *13217* (srh, GH, MARY, MO, NY, TAES, VT).

POLYGALACEAE

Polygala sanguinea L., Common milkwort. Scarce, Disturbed land, Freshwater marshes, Stable. *21734* (srh, CLEMS, GH, NYS).

POLYGONACEAE

**Polygonum aviculare* L., Knotweed. Infrequent, Disturbed land, Coastal beaches and dunes, Stable. *8754* (srh, MARY, VT).

**Polygonum convolvulus* L., Black bindweed. Occasional, Disturbed land, Stable. *21767* (CLEMS, NY, NYS); *22482* (CLEMS, GH, NY, TAES, USF).

**Polygonum cuspidatum* Sieb. & Zucc., Japanese bamboo. Infrequent, Disturbed land, Stable. *22507* (srh, CLEMS, GH, NY, USF).

**Polygonum hydropiper* L., Water-pepper. Occasional, Disturbed land, Stable. *21686* (srh, CLEMS, NYS); *22508* (srh, CLEMS, GH, NY, TAES, USF).

Polygonum hydropiperoides Michx., Mild water-pepper. Occasional, Freshwater marshes, Stable. *9358* (MARY, NY, TAES, VT); *9369* (MARY, NY, TAES, VT).

Polygonum pensylvanicum L., Smartweed. Occasional, Disturbed land, Coastal beaches and dunes, Stable. *21633* (srh, CLEMS).

**Polygonum persicaria* L. [incl. *P. dubium* Stein], Lady's-thumb. Occasional, Disturbed land, Stable. *22505* (srh, CLEMS, GH, NY, USF); *22509* (srh, CLEMS).

Polygonum punctatum Ell., Smartweed. Occasional, Disturbed land, Freshwater marshes, Stable. *8732* (srh, MARY, VT).

Polygonum ramosissimum Michx., Knotweed. Occasional, Tidal marshes, Stable. *9434* (srh, MARY, MO, NY, TAES, VT).

Polygonum sagittatum L., Tear thumb. Infrequent, Freshwater marshes, Stable. *21754* (srh, CLEMS, NYS).

Polygonum scandens L., Climbing wild buckwheat. Occasional, Disturbed land, Stable. *935* (VT) *8737* (srh, MARY, NY, TAES, VT).

**Rumex acetosella* L., Sour-grass. Occasional, Disturbed land, Stable. *21611* (srh, CLEMS, GH, NY, NYS).

**Rumex crispus* L., Curly dock. Occasional, Disturbed land, Stable. *21604* (srh, CLEMS, GH, NY, NYS).

PORTULACACEAE

**Portulaca oleracea* L., Purslane. Occasional, Disturbed land, Stable. *21639* (srh, CLEMS).

PRIMULACEAE

**Lysimachia punctata* L., Garden loosestrife. Infrequent to Occasional, Disturbed land, Increasing. Only in cultivation through the early 1980s, the species has escaped and become successfully established on the Point in the late 1980s and early 1990s. Latimer Point garden, 28 Jun 1982, *11802* (srh, MARY, NY, VT); SW quadrant of Latimer Point near main beach, 17 Jul 1990, *21644* (srh, CLEMS, GH, LG, NCU, NY, TAES, USF).

Lysimachia quadrifolia L., Whorled loosestrife. Occasional, Oak forest, Stable. *21715* (srh, CLEMS, GH, NCU, NY).

PYROLACEAE [within Ericaceae in Tucker 1995]

Chimaphila maculata (L.) Pursh, Spotted wintergreen. Scarce, Oak forest, Stable. *21782* (srh).

Pyrola elliptica Nutt., Common shinleaf. Scarce, Oak forest, Shrub swamps, Stable. *22485* (srh, CLEMS).

RANUNCULACEAE

Anemone quinquefolia L., Windflower. Occasional, Oak forest, Stable. *10082* (srh, MARY, NY, VT); *23088* (srh, CLEMS, GH, MO, NY, USF).

Clematis virginiana L., Clematis. Scarce, Oak forest margin, Stable. *21784* (srh, CLEMS, GH, MO).

**Consolida ambigua* (L.) P.W. Ball & Heywood [*Delphinium ajacis* L.], Delphinium. Scarce, Disturbed land, Waif. *17062* (srh, VT).

**Ranunculus bulbosus* L., Bulbous buttercup. Infrequent, Disturbed land, Increasing. *21743* (srh, CLEMS); *23104* (srh, CLEMS).

Thalictrum pubescens Pursh [*T. polygamum* Muhl.], Tall meadow rue. Infrequent, margins of Oak forest and Shrub swamps, Stable. *9309* (MO, NY, VT); *9353* (srh); *21656* (CLEMS, GH, NY, NYS, TAES, USF).

RHAMNACEAE

**Rhamnus frangula* L., Alder buckthorn. Infrequent, Disturbed land, Increasing. A new arrival on the Point, first noted with this collection. NE quadrant of Latimer Point, 5 Aug 1991, *22473* (srh, CLEMS, NY, TAES).

ROSACEAE

Amelanchier canadensis (L.) Medikus, Shadbush. Frequent, Oak forest, Stable. *9114* (srh, NY, VT); *23100* (srh, CLEMS, GH, ILLS, MO, NY, SMU, TAES, TEX, USF).

Aronia arbutifolia (L.) Ell., Red chokeberry. Infrequent, Freshwater marshes, Disturbed land, Stable. *9386* (srh, MARY, NY, TAES, VT).

Aronia prunifolia (Marsh.) Rehd., Chokeberry. Occasional, Oak forest margin, Stable. *9105* (srh, MARY, VT).

Crataegus pruinosa (Wendl. f.) K. Koch, Hawthorn. Infrequent, Shrub swamps, Oak forest margin, Stable. *10094* (srh, GH, MARY, MO, NY, TAES, VT).

Fragaria virginiana Duchesne, Wild strawberry. Occasional, Disturbed land, Stable. *21657* (srh, CLEMS, GH, MOR); *23107* (srh, CLEMS).

Geum canadense Jacq., White avens. Occasional, Disturbed land, Stable. *21618* (CLEMS, MOR).

**Malus floribunda* Sieb., Flowering crabapple. Infrequent, Disturbed land, Stable. *23096* (srh, ILLS, TAES, USF).

**Malus pumila* Mill. [*Pyrus malus* auth.], Wild apple. Infrequent, Oak forest margin, Disturbed land, Stable. *9104* (srh, MARY, VT).

**Potentilla argentea* L., Silvery cinquefoil. Infrequent, Disturbed land, Stable. *10069* (srh).

Potentilla canadensis L., Common cinquefoil. Occasional, Disturbed land, Stable. *23122* (CLEMS, GH, MO, NY, USF).

Potentilla norvegica L., Rough cinquefoil. Infrequent, Disturbed land, Stable. *9392* (srh); *21647* (srh). According to Gleason and Cronquist (1991) our plants may or may not be native.

**Potentilla recta* L., Upright cinquefoil. Scarce, Disturbed land, Stable. *21729* (srh, CLEMS).

Potentilla simplex Michx., Cinquefoil. Occasional, Oak forest margin, Disturbed land, Stable. *10099* (srh, MARY, NY, TAES, VT).

Prunus serotina Ehrh., Wild black cherry. Occasional to Frequent, Oak forest margins, Disturbed land, Stable. *9408* (srh, MARY, MO, NY, TAES, VT).

**Pyrus communis* L., Pear. Scarce, Disturbed land, Stable. *10068* (srh, GH, MARY, MO, NY, TAES, VT).

**Rosa multiflora* Thunb., Multiflora rose. Occasional to locally frequent, Disturbed land, Oak forest margin, Stable. *11804* (srh, MARY, NY, VT).

**Rosa rugosa* Thunb., Beach rose. Occasional, Coastal beaches and dunes, Stable. *314* (VT); *8755* (srh, MARY). The white flowered form also occurs here but is scarce: *315* (VT); *21779* (srh, CLEMS, MOR).

Rosa virginiana Miller, Wild rose. Occasional to Frequent, margin of Oak forest, Tidal marshes, Stable. *293* (VT); *9313* (srh MARY, MO, NY, TAES, VT); *10804* (srh, MARY, NY, TAES, VT); *11805* (srh, MARY, NY, TAES, VT).

Rubus allegheniensis Porter ex Bailey, Northern blackberry. Occasional, Disturbed land, Stable. *21666* (srh, CLEMS, GH, NY, MOR).

Rubus flagellaris Willd., Northern dewberry. Occasional, Disturbed land, Stable. *10093* (srh, GH, MARY, NY, TAES, VT).

Spiraea alba Duroi var. *latifolia* (Ait.) Dippel, Meadowsweet. Occasional, Freshwater marsh, Stable. *9376* (srh, MARY, NY, VT).

Spiraea tomentosa L., Steeplebush. Occasional, Freshwater marsh, Stable. *9370* (srh, GH, MARY, MO, NY, TAES, VT).

RUBIACEAE

**Galium aparine* L., Bedstraw. Occasional, Disturbed land, Stable. *23119* (srh, CLEMS, NY, USF).

**Galium mollugo* L., White bedstraw. Occasional, Disturbed land, Stable. *21752* (srh, CLEMS, NYS).

Galium obtusum Bigel., Marsh bedstraw. Occasional, Freshwater marshes, Stable. *1164* (VT as *G. tinctorium*); *9365* (srh, MARY, NY, VT).

SALICACEAE

**Populus alba* L., White poplar. Infrequent, Disturbed land, Stable. *10072* (srh, GH, MARY, MO, NY, TAES, VT).

Populus tremuloides Michx., Quaking aspen. Infrequent, Disturbed land, Increasing. *21665* (srh, CLEMS, GH, NY, MOR); *23093* (srh, CLEMS).

**Salix alba* L., White willow. Occasional, Disturbed land, Stable. *21758* (srh, CLEMS).

**Salix cinerea* L., Ashy European willow. Infrequent, Shrub swamps, Stable. *9119* (srh, MARY, MO, NY, VT).

Salix eriocephala Michx., Wand willow. Infrequent, Shrub swamps, Stable. *10076* (srh, MARY, NY, TAES, VT); *23082* (srh, ILLS, NY, SMU, TAES, USF).

SCROPHULARIACEAE

Agalinis maritima (Raf.) Raf., Salt marsh gerardia. Occasional, Tidal marshes, Stable. *929* (NY, VT); *9433* (srh, MARY, MO, NY, TAES, VT); *13218* (GH, MARY, MO, NY, TAES, VT).

Linaria canadensis (L.) Dum.-Cours., Toadflax. Occasional, Disturbed land, Stable. *1155* (VT); *9331* (srh, MARY, TAES, VT).

**Linaria vulgaris* Mill., Butter-and-eggs. Occasional, Disturbed land, Stable. *9394* (srh).

Lindernia anagallidea (Michx.) Pennell, False pimpernel. Infrequent, Freshwater marshes, Stable. *9375* (srh, MARY, NY, VT).

**Paulownia tomentosa* (Thunb.) Sieb. & Zucc. ex Steud., Princess tree. Infrequent, Disturbed land, Increasing. Not seen in the area until first sighting in 1991, it is likely to become much more common in the future since this individual was already fertile though only 3 m tall. Dodges Island, 8 Aug 1991, *22516* (srh, CLEMS, GH, NY) [included in Bignoniaceae by Tucker 1995].

Scrophularia lanceolata Pursh, Figwort. Occasional, Disturbed land, Stable. *7445* (srh, TAES, VT); *11834* (srh, GH, MARY, MO, NY, TAES, VT, WS).

**Verbascum thapsus* L., Common mullein. Infrequent to Occasional, Disturbed land, Stable. *21602* (CLEMS, ISC, NY).

**Veronica arvensis* L., Corn speedwell. Occasional, Disturbed land, Stable. *23125* (CLEMS, GH, MO, NY, TAES, USF).

Veronica peregrina L. subsp. *peregrina*, Neckweed. Occasional, Disturbed land, Stable. *10246* (srh, GH, MARY, MO, NY, TAES, VT); *21606* (CLEMS).

SIMAROUBACEAE

**Ailanthus altissima* (Mill.) Swingle, Tree-of-Heaven. Infrequent to locally Frequent, Disturbed land, Increasing. A few trees were found already mature on Dodges Island in 1980; by 1982 this had become an almost pure grove taking the place of *Prunus*, *Rhus* and *Myrica* at this site. In 1991 one individual was first seen on Latimer Point opposite Dodges Island near the main beach. It is likely to become much more common in the future. Dodges Island, 16 Aug

1980, *9448* (srh, MARY, MO, NY, TAES, VT); same locality, 12 Jul 1982, *11831* (CLEMS, GH, MARY, NY, TAES, VT); same locality, *11832* (srh, GH, MARY, NY, TAES, VT).

SOLANACEAE

**Datura stramonium* L., Jimson-weed. Occasional, Coastal beaches and dunes, Disturbed land, Stable. Most common around dead *Zostera* piles at the upper beach strand. *791* (VT); *8738* (srh, MARY).

**Physalis alkekengi* L., Chinese lanterns. Scarce, Disturbed land, Stable. *21725* (srh, CLEMS).

**Solanum dulcamara* L., Climbing nightshade. Occasional, Disturbed land, Stable. *21616* (srh, CLEMS, CTES, GH, NY, NYS, TAES, USF).

Solanum ptychanthum Dun. ex DC. [*S. americanum* auth., often incl. within *S. nigrum* L.], Black nightshade. Occasional, Coastal beaches and dunes, Disturbed land, Stable. *945* (GH, NY, VT); *21637* (srh).

ULMACEAE

Ulmus americana L., American elm. Occasional to Infrequent, Shrub swamps, Declining. Upper leaf surfaces rough in this population. As in most of New England, large mature trees of the species have declined due to Dutch Elm disease, but younger trees still seem to survive and reproduce. *21722* (CLEMS, GH, LG, NY, NYS, USF).

URTICACEAE

Urtica dioica L. subsp. *gracilis* (Ait.) Solander, Stinging nettle. Infrequent, Disturbed land, Increasing. *10798* (srh, MARY).

VERBENACEAE

Verbena hastata L., Blue vervain. Occasional, Disturbed land, Stable. *9449* (srh, MARY, NY, TAES, VT); *21614* (CLEMS, GH, NY, NYS).

VIOLACEAE

Viola fimbriatula Sm., Northern downy violet. Infrequent, Disturbed land, Stable. *21684* (srh, CLEMS).

Viola lanceolata L., Lance-leaf violet. Infrequent, Disturbed land, Stable. *1165* (VT); *9108* (MARY); *21683* (srh).

**Viola priceana* Pollard [often incl. in *V. sororia* Willd.], Confederate violet. Infrequent, Disturbed land, Stable. SE quadrant of Latimer Point, residential area lawn weed, 13 May 1992, *23103* (srh). First report for southeastern Connecticut, but probably included previously within *V. sororia*.

Viola sagittata Ait. [may = *V. fimbriatula* Sm.], Arrow-leaf violet. *23081* (srh, CLEMS, NY).

**Viola sororia* Willd., Common blue violet. Occasional, Disturbed land, Stable. *23121* (CLEMS, GH, NY, USF).

**Viola tricolor* L., Johnny-jump-up. Scarce, Disturbed land, Waif. Escape from gardens, may not persist for long. SE quadrant Latimer Point, 5 Jul 1980, *9333* (srh, MARY).

VITACEAE

**Ampelopsis cordata* Michx. Scarce, Disturbed land, Increasing. First seen in 1980 along Pequotsepos Road just outside of this study area, it has now spread closer to the Point. S side US Rt. 1 near VFW post opposite Long Wharf Road in landfill, 7 Aug 1991, *22506* (srh, CLEMS, GH, NY).

Parthenocissus quinquefolia (L.) Planchon, Virginia creeper. Frequent, Oak forest, Disturbed land, Stable. Similar to and confused with *Parthenocissus vitifolia* (Knerr) A. Hitchc., which has been collected in nearby Mystic and may also occur on the Point. *21661* (srh, CLEMS, GH, LG, NY, NYS).

Vitis labrusca L., Fox grape. Abundant, Oak forest margins, Stable. *11807* (srh, GH, MARY, MO, NY, OKL, OSC, RENO, TAES, UTC, VT, WIS, WS).

DISCUSSION

Seymour (1969) reports 2882 vascular plant species present in New England, 2005 (70%) of which are native and 877 (30%) of which are non-native. Dowhan (1979) reports 2489 vascular plant species in Connecticut, 1636 (66%) of which are native and 853 (34%) of which are non-native. Tucker (1995) reports 1550 vascular plant species in southeastern Connecticut of which 1170 (75%) are native and 380 (25%) non-native. The flora of Latimer Point and vicinity includes 385 vascular plant species, 248 (64%) of which are native taxa and 137 (36%) of which are non-native. The proportion of native and non-native species in these floras remains rather constant despite major differences in coverage area. This list represents primarily the coastal element of the flora reported by Tucker (nearly 25% of the total flora of southeastern Connecticut or nearly 16% of the entire state flora).

The flora of Latimer Point and vicinity was searched out and studied during the period 1969 to 1992. Four-hundred twenty-seven taxa of plants are listed in this paper, of which 30 are marine macroalgae, 12 are mosses, 10 are ferns and fern allies, 1 is a conifer, and 374 are flowering plants (107 monocots and 267 dicots). There are 92 vascular plant families represented, the five largest being Poaceae (53 taxa), Asteraceae (39), Cyperaceae (25), Rosaceae (22), and Fabaceae (20). The two largest genera represented are *Carex* and *Polygonum*, each with 11 species. Among the elements of the flora, 381 taxa have had stable populations during the period, 30 have seen their numbers increase (23 exotics and 7 natives), and 16 have seen their numbers decline (3 exotics and 13 natives). One species (*Honckenya peploides*) was found which has been listed as a Connecticut Species of

Special Concern. One species listed as endangered in Connecticut (*Ligusticum scothicum*) was also found, and another (*Angelica lucida*) has been reported from the study site.

Seven plant habitats are described in the vicinity of Latimer Point, and the numbers of all taxa most commonly found in each include 32 in the estuaries, 22 on the coastal beaches and dunes, 30 in the tidal marshes, 44 in the freshwater marshes, 25 in the shrub swamps, 63 in the oak forest, and 211 on disturbed lands. The large percentage (49%) of taxa found primarily in disturbed areas reflects the history of human and natural coastal disturbance characteristic of coastal New England today.

Exotic species have increased in disturbed areas, but not in the more mature plant associations. Of the 23 exotics that have become more common over the past 24 years, 9 have presumably been dispersed widely by birds which eat their fleshy fruits (*Ampelopsis cordata*, *Berberis thunbergii*, *B. thunbergii* var. *atropurpurea*, *Elaeagnus umbellata*, *Euonymus alatus*, *Ligustrum vulgare*, *Lonicera japonica*, *Lonicera morrowii*, *Rhamnus frangula*). Seven of the increasing exotics are dispersed primarily by wind (*Acer platanoides*, *Acer pseudoplatanus*, *Hypochoeris maculata*, *Lactuca serriola*, *Sonchus arvensis*, *Paulownia tomentosa*, *Ailanthus altissima*). One is a recent garden escape (*Lysimachia punctata*) and the remainder are opportunistic species that have increased by chance with human disturbance of the landscape (*Artemisia vulgaris*, *Centaurea maculosa*, *Chelidonium majus*, *Ipomoea purpurea*, *Ranunculus bulbosus*, *Spergularia marina*). Seven species (*Abutilon theophrasti*, *Consolida ambigua*, *Eschscholzia californica*, *Panicum millaceum*, *Silene armeria*, *Stachys byzantina*, *Viola tricolor*) were seen once and not again and are reported here as waifs; of these the first and fourth are widespread weeds which may have been introduced in bird seed or fill dirt, and the remaining five are all garden plants that were probably casually discarded and were only briefly established. The flora and fauna have been impacted by human activities resulting in a high percentage of non-native species, but the remaining native terrestrial flora has not seriously declined.

Seven native species increased their numbers during the observation period. The green alga *Cladophora albida* has possibly increased due to increased nutrient content (pollution) of the coastal waters. *Cuscuta pentagona*, dodder, is an opportunist with no obvious reason for its increase. *Dennstaedtia punctilobula* is

a fern which has increased due to brush clearing near the residential areas of the point because it prefers this open habitat to a closed canopy. *Lycopus americanus* and *Phragmites australis* have expanded along US Rt. 1 because of increased trenching of roadsides and disturbance of wetland communities in this area. *Populus tremuloides* and *Urtica dioica* may be increasing their ranges due to increased disturbance along roadsides.

Sixteen species declined in numbers of individuals during the period of observation. Three of these were exotic species which apparently were not very competitive with the native flora or their fellow exotics (*Anthemis cotula*, *Artemisia stelleriana*, *Berberis vulgaris*). Among the 13 native species in decline, 3 are marine algae that may be decreasing due to pollution, though other factors may be involved (*Chondrus crispus*, *Dasya baillouviana*, *Leathesia difformis*). The filling of wetlands, as well as increased herbicide use along the railroad which passes through the wetlands, may be responsible for the decline in four species (*Carex intumescens*, *Cyperus diandrus*, *Hibiscus palustris*, *Nymphaea odorata*). It is tempting to speculate that warming of the environment is responsible in part for the decline in three generally more northern species (*Honckenya peploides*, *Osmunda claytoniana*, *Plantago maritima*). Predation by gypsy moths was the apparent cause for a decline in *Quercus bicolor*, and Dutch elm disease has continued to take its toll on *Ulmus americana*. *Betula populifolia* seems to be in decline due to the increased use of herbicides along the woodland margins bordering the railroad, a habitat which it prefers.

I was able to observe several other vegetation changes over time. During the 24 year observation period the trees of the oak forest became taller and more massive despite several hurricanes and storms. As shade increased, the *Smilax* and *Vitis* colonies have declined slightly in the former openings in the forest. The *Zostera* populations in the bay have fluctuated greatly; there was a period in the 1970s and 1980s when there were none to be found, while in the late 1980s and early 1990s it was difficult to get a boat through the massive colonies in the estuaries. The flora is in rather good condition. Since the beginning of my observations, no native taxa have been lost. However, there is an influx of exotic species still taking place, and the more fragile islands and any disturbed lands soon may have forests dominated by *Ailanthus altissima* and *Paulownia tomentosa*, if they do not al-

ready. Furthermore, the native white-tailed deer population has increased noticeably with the lack of hunting and the increased foraging may lead to a decline of the more edible species. The deer sometimes are seen swimming from island to island.

The coastal flora is a resilient one; it has developed in the presence of storms, tidal surges, erosion and other disturbance, so humankind probably cannot destroy it completely except by paving it over. However, the mature oak forests of the area have been gone for well over 150 years and are unlikely to return any time soon. Gypsy moths arrived in the area in the early 1980s and for several years in succession stripped the oaks (especially *Quercus bicolor*) of leaves. The infestation seems to have stabilized and is in decline in the early 1990s.

The aquatic animals have declined. When I first started exploring the area, harbour seals sometimes were seen on the rocks at Lyddy Island and the outer islands were homes to large colonies of common terns. In the clear shallow waters, horseshoe crabs were common, and edible fish such as flounder and blackfish were plentiful offshore. Steamer clams could be dug somewhat easily in the mudflats of the estuaries. During these earlier years, sea urchins and sea cucumbers could be found in the lower tide pools, squid sometimes were found breeding in the shallow waters north of Lyddy Island, and blue mussels abounded. While this area has been spared of much of the pollution found in other parts of coastal Connecticut it has not been spared all of it. In the last decade and a half the fishing areas and shellfish beds have been closed often due to algal and bacterial blooms, which, along with silt, nearly obscure the formerly clear waters. The coastal trawlers (and, possibly, pollution) have eliminated nearly all of the edible sport fish. The mussels and steamer clams nearly are gone (probably due to over-harvesting as well as siltation), and I have not seen a sea urchin, or sea cucumber, or even a starfish there for years. On the encouraging side, the central portion of Latimer Point has been protected from development by The Nature Conservancy, the bird and mammal fauna seems healthy, quahogs and cherrystone clams are rather common, and a seal or two has been seen again in Fishers Island Sound.

ACKNOWLEDGMENTS. I would like to thank the late Frank Gould (TAES) for assistance with the identification of some grasses, Tony Reznicek (MICH) and Gordon Tucker (NYS, now at EIU)

for assistance with sedge identifications, Craig W. Schneider (tr) for assistance with the algae, and Lewis Anderson (DUKE) for assistance with the mosses. I also thank Stacey Kingsbury of the Connecticut Natural Resources Center for information on historical species records for listed Connecticut plants. Comments on the manuscript by Rick Phillippe and Geoff Levin (both ILLS) and two anonymous reviewers have been especially useful. Special thanks go to my parents Margaret E. and Richard J. Hill, to whom this paper is dedicated, for putting up with a budding botanist and the inconveniences and associated messes over the years of this study, and for constant encouragement to explore and retain a sense of wonder.

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RHODORA, Vol. 98, No. 894, pp. 217, 1996

BOOK REVIEW

Howard, Richard A. 1996. *An Almanac of Botanical Trivia.* 52 pp. $7.00 (paper). Privately published by the author, 4 Jefferson Drive, Acton, MA 01720.

All of us doubtless have our little collections of curious trivia, produced from time to time for enlightenment, embellishment, or entertainment of classes, after-dinner audiences, friends at parties, or ceremonial presentations ["there must be some great significance, my colleague, to your retiring on May 24, the anniversary of the birth of Linnaeus . . . "]. Surely few if any botanists have so large a store of trivia as Dr. Howard, and none have done so systematic a job of curating their collection.

The booklet at hand is arranged chronologically, with most days of the year represented by one or more statements of birth, death, first-day postal issues, bizarre occurrences in the lives of botanists, or other historic facts. Some less precisely dated items are added and an appendix lists generic names that are anagrams of others (e.g., Filago, Gifola, Ifloga, Logfia). I learn that the day on which my review copy arrived was the 40th anniversary of the death of H. N. Ridley "at age 100 plus 10 months." The day on which I mail my review to the editor is the 181st anniversary of the shipwreck of C. S. Rafinesque off Long Island ("after the War of 1912" [sic]). A few of the events celebrated are the same as those on the fascinating wall calendars published by the Missouri Botanical Garden (sharing even their misspelling of the birthplace of Asa Gray on November 18, 1810). But many of the "trivia" are not easily found elsewhere. (I had not previously realized that I share a birthday with William Trelease.)

The author solicits additional items, so perhaps larger—but never complete—editions are contemplated. I suggest for the next one the addition of October 18, 1993: death of Ralph R. Stewart, at the age of 103 years plus 6 months, thus well surpassing H. N. Ridley's record as the longest-lived botanist. And I suggest adding July 1, 1917, birthdate of the energetic assembler without whose efforts we would not have this delightful compilation.

—Edward G. Voss, University of Michigan Herbarium, Ann Arbor, MI 48109-1057.

RHODORA, Vol. 98, No. 894, pp. 218–219, 1996

BOOK REVIEW

Semple, John C. 1996. *A Revision of* Heterotheca *sect.* Phyllotheca *(Nutt.) Harms (Compositae: Astereae): The Prairie and Montane Goldenasters of North America.* University of Waterloo Biology Series No. 37. 164 pp., illus. $15.00 plus $5.00 shipping and handling (paper). Published by U. W. Biology Series, Department of Biology, University of Waterloo, Waterloo, Ontario, Canada N2L 3G1.

The goldenasters (golden asters) and camphorweeds are yellow-flowered, summer and fall-blooming, annual and perennial herbs ranging in eastern North America from the Massachusetts coastal plain south into Texas and in the west from Canada to southern Mexico. Their generic circumscriptions have been "in turmoil" (Semple's phrase) since the early 1950s. Thus the only somewhat widespread New England species, *Chrysopsis falcata* (Pursh) Ell. in the great mid-century floras of the region, became for a time *Heterotheca falcata* (Pursh) Harms and is now *Pityopsis falcata* (Pursh) Nutt., a name it will seemingly retain in *Flora North America*. This very well done monograph would be useful alone for its introductory sections expounding the nomenclatural history of this complex group.

According to Semple, most North American goldenasters are divided among *Chrysopsis* (9 species), *Heterotheca* (28 species), and *Pityopsis* (7 species). *Pityopsis* and *Chrysopsis* are centered in the southeastern United States while *Heterotheca* is most abundant and diverse in the west. Within the United States, *Heterotheca* sect. *Phyllotheca* occurs largely in the prairie and montane regions west of the Mississippi, although *H. camporum* (Greene) Shinners var. *camporum* extends through the Prairie Peninsula region into western Indiana and *H. camporum* var. *glandulissimum* Semple has recently spread to a number of eastern sites.

Perhaps surprisingly, most of the twenty species in sect. *Phyllotheca* and their varieties historically have been included within *Chrysopsis villosa* (Pursh) Nutt., characterized by H. A. Gleason in 1952 as "a complex and poorly understood aggregate species, of uncertain limits," its often distinctive varieties "connected by numerous intergrades." Semple, in revising the group, has taken on a daunting task, and at the very least has established a coherent system for a widespread and protean assemblage, with clear de-

scriptions of its taxa. His taxonomic treatment includes keys to the three sections and 28 species of *Heterotheca* and their varieties, a general summary of section *Phyllotheca*, and accounts of each of its species and varieties. Included are range maps in sufficient detail to delight the biogeographers among us and black and white illustrations showing growth habit, leaves, and, in very fine detail, the reproductive structures of each taxon. There are also lengthy lists of cited specimens and narrative discussions with notes on aberrant or atypical forms, potentially very useful information of a sort too quickly glossed over in broad floristic treatments. Semple warns the reader early-on that the taxa within *Phyllotheca* are defined by combinations of traits rather than by single diagnostic features and that within most species, leaf indument (often featured prominently within his keys) varies in a gradient from taxa possessing numerous hairs and few or no glands to closely related forms with few hairs and many glands. Indeed, within some specimens, the indument of the basal leaves may vary sharply from that of the upper leaves, reflecting different environmental conditions at the time of leaf formation.

Thus, I suspect that despite Dr. Semple's efforts, because of its inherent variability, section *Phyllotheca* will continue to present difficulties for field biologists. Hence, whether or not his treatment, which proposes six new names and combinations within section *Phyllotheca* alone, will survive the inevitable revisions of the 21st Century, is very much an open question. If his structure is in time dismantled, he has nonetheless brought together here the building blocks to shape another.

—C. John Burk, Department of Biological Sciences, Smith College, Northampton, MA 01063.

RHODORA, Vol. 98, No. 894, pp. 220–222, 1996

NEBC MEETING NEWS

April 1996. Dr. Christopher Campbell of the University of Maine spoke on "Visions of Sugar Plums Dancing in My Head: An Apomictic Nightmare." He was led to the study of the very difficult genus *Amelanchier* in part because he lives in the center of diversity of the genus, and because the University thoughtfully planted research material at the door of his office. He obviously hadn't read Ed Voss's statement that "The only advantage that *Amelanchier* has over *Crataegus* and *Rubus* is that, by being smaller, it lures us to the hope that it will be more manageable."

The shadbushes are a taxonomic nightmare, and appear to be a complex of hybrids and apomictic (asexual) taxa that are referred to as "microspecies." Dr. Campbell has been investigating whether agamospermy actually is responsible for the formation of microspecies, attempting to determine how much hybridization actually occurs, and the extent to which these two forces shape evolution in the genus.

Amelanchier appears to be an old genus, represented in eastern Asia, Europe, and Asia Minor, as well as in western and eastern North America where the highest diversity occurs. One species of western North America, *A. alnifolia,* is cultivated for its edible fruits known as "sugarplums." Although not morphologically distinct, the western and eastern North American taxa are highly distinct genetically. This genetic difference is most clearly reflected in fruit taste—all of the tasty species are western, with the exception of the eastern *A. humilis.* There is no consensus on the actual number of species in the genus; various treatments range from 6 to 33, with virtually all of the taxa polyploid and most at least facultatively agamospermic. All possible hybrids have been reported for the New England taxa.

Dr. Campbell's research has combined studies of morphological and genetic variation, as well as experimental hybridizations. A series of controlled crosses shows that inheritance of genetic markers is strongly maternal, indicating that hybridization rarely occurs and that sex is not responsible for the introduction of genetic variation. He compared within and among population variation for *Amelanchier bartramiana* (a sexual species) and *A. laevis* (an agamospermous species). This research has shown that, contrary to most hypotheses, sexual and apomictic species do not partition variation differently, and that variation is greater in the

sexual species. Results were not conclusive on the question of whether agamospermy is responsible for the formation of microspecies. This research on hybridization has shown clearly that *Amelanchier* × *neglecta* is a hybrid of *A. bartramiana* and *A. laevis,* with the apomictic *A. laevis* serving as the pollen parent. *Amelanchier* × *neglecta* is almost entirely agamospermous, with no evidence of backcrossing with its parents.

Other research on a confusing plant known informally as *Amelanchier* "humilopsis" suggests that it is an old hybrid of *A. humilis* and an unknown species, both agamospermous. This plant has an unusual multigene polymorphism that is maintained by agamospermy. Dr. Campbell has observed "humilopsis" and *A. laevis* hybridizing at a disturbed site, and hypothesizes that Fernald saw these plants as a child growing up in Orono.

It appears that agamospermy by itself does not generate variation in *Amelanchier*, but perpetuates the diversity that results from extensive hybridization. Future attempts to resolve the taxonomy of *Amelanchier* should identify and focus on the sexual species that are the oldest and most stable members of the genus.

May 1996. Dr. Gregory Anderson, of the University of Connecticut at Storrs, spoke on "The Origin and Evolution of the Pepino, One of the Forgotten Domesticates of the Incas."

The Pepino (*Solanum muricatum*) is truly a lost crop, with no known wild progenitors. Domesticated prior to the Incas in the Ecuador/Columbia/Peru area, pepinos appear in pottery dating back 2,000–3,000 years, but were not much cultivated by Incan cultures. The name derives from the Spanish, who named it "pepino dulce" to distinguish it from the earlier-named "pepino" or cucumber. Now becoming more popular as a "dessert-quality subacid fruit" with a high vitamin C content, it is cultivated from Mexico to Chile as well as in New Zealand.

Pepinos exhibit great variation in fruit morphology, consistent with the "first law of economic botany," which states that the greatest variation occurs in that feature for which the species was cultivated. The result of recent intensive cultivation has been a substantial loss in fruit diversity.

Morphological studies suggested that there were 3 candidates for the wild progenitor of pepino: *Solanum tabanoense, S. caripense,* and *S. basendopogon.* Studies by Greg and numerous collaborators have examined "traditional" biosystematic evidence

from breeding systems, genetic relationships, flavinoids, meiotic behavior, and mitotic chromosome structure. These studies suggested that relationships based on morphology should be revised, and indicated that *Solanum caripense* was most closely related to the pepino.

More recent studies have focused on molecular evidence using chloroplast and nuclear DNA sequencing. These DNA studies indicate that *Solanum tabanoense*, not *S. caripense*, is most closely related to the pepino. However, some collections of pepino were very similar to *S. caripense*. These data are best explained by the hypothesis that pepino was domesticated from *S. tabanoense*, and later was hybridized with *S. caripense*. The large range of morphological variation in the pepino is likely to be the result of this post-origin hybridization.

—Lisa A. Standley, Recording Secretary.

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Submission of a manuscript implies it is not being considered for publication simultaneously elsewhere, either in whole or in part.

GENERAL: Manuscripts should be submitted in triplicate. The text must be double-spaced throughout, including tables, figure legends, and literature citations. Use a non-proportional font throughout and do not justify the right margin. Do not indicate the style of type through the use of capitals, underscoring, or bold, except for names of genera and species which should be in italics or underscored throughout. Do not underline punctuation. All pages should be numbered in the upper right-hand corner. For guidance in matters not addressed here, consult the editorial office by phone at (603) 862-3205, FAX (603) 862-4756, or e-mail: janets@christa.unh.edu. Brevity is urged for all submissions.

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ABSTRACT: An abstract and a list of key words should be included with each paper, except for shorter papers submitted as Notes. An abstract must be one paragraph, and should not include literature citations or taxonomic authorities. Please be concise, while including information about the paper's intent, materials and methods, results, and significance of findings.

TEXT: Main headings are all capital letters and centered on one line. Examples are: MATERIALS AND METHODS, RESULTS, and DISCUSSION. Do not title the Introduction. Do not combine sections of the paper (such as Results and Discussion), or use Conclusions or Summary. Second level headings should be indented, bold, upper and lower case, and end with a period. Taxonomic authorities should be cited for all species names at their first usage in the text, or in a referenced table. Cite each figure and table in the text in numerical order. Each reference cited in the text must be in the Literature Cited. Cross-check spelling of author(s) name(s) and dates of publication. Literature citations in the text should be as follows: Hill (1982) or (Hill 1982). For two or more authors, cite as follows: Angelo and Boufford (1996) or (Angelo and Boufford 1996). Within parenthesis, use a semicolon to separate different types of citations (Hill 1982; Angelo and Boufford 1996) or (Figure 4; Table 2).

FLORAS AND TAXONOMIC TREATMENTS: Specimen citation should be selected critically, especially for common species of broad distribution. Keys and synonymy for systematic revisions should be prepared in the style of "A Monograph of the Genus *Malvastrum*,"

S. R. Hill, RHODORA 84: 159–264, 1982. Designation of a new taxon should carry a Latin diagnosis (rather than a full Latin description), which sets forth succinctly how the new taxon differs from its congeners.

LITERATURE CITED: All bibliographic entries must be cited in the paper, unless a special exception has been made by the Editor (such papers will be allowed a REFERENCES section). Verify all entries against original sources, paying special attention to spelling and details of publication. Cite references in strict alphabetical order by first author's surname. Do not write authors' names in all capital letters. References by a single author precede multi-authored works of same senior author, regardless of date. Use a long dash when the author(s) are the same as in the entry immediately preceding (see recent issues). Refer to Botanico-Periodicum-Huntianum (B-P-H 1968) and B-P-H/Supplement (1991) for standardized abbreviations for journals.

TABLES: Tables must be double-spaced. Tables may be continued on an extra page, if necessary. As much as possible, the title should be self-explanatory. Do not use footnotes; instead, add notes after the end of the table title. Broadside tables should be avoided, if possible. Each table should be cited in the text in numerical order.

FIGURES: Illustrations must be either black and white half-tones (photograph), drawings, or graphs. Illustrations must be camera-ready; flaws cannot be corrected by the Editor or the printer. Add symbols or shading with press-on sheets. The printed plate will be 4×6 inches; be sure that illustrations are proportioned to reduce correctly. Allow space for a caption, if possible. Magnification/reduction values should be calculated to reflect the actual printed size. Maps must indicate scale and compass direction. The double-spaced list of legends for figures should be provided on a separate page. Each figure should be cited in the text in numerical order.

THE NEW ENGLAND BOTANICAL CLUB
22 Divinity Avenue
Cambridge, MA 02138

The New England Botanical Club is a non-profit organization that promotes the study of plants of North America, especially the flora of New England and adjacent areas. The Club holds regular meetings, and has a large herbarium of New England plants and a library. It publishes a quarterly journal, RHODORA, which is now in its 99th year and contains about 400 pages per volume. Visit our web site at http://www.herbaria.harvard.edu/nebc/

Membership is open to all persons interested in systematics and field botany. Annual dues are $35.00, including a subscription to RHODORA. Members living within about 200 miles of Boston receive notices of the Club meetings.

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RHODORA, Vol. 98, No. 894, pp. 226–231, 1996

BYLAWS
OF
THE NEW ENGLAND BOTANICAL CLUB, INCORPORATED

(To repeal and replace all previous Bylaws)

Adopted by the membership 5 April 1996
Bylaws last published: *Rhodora,* vol. 91, no. 867, pp. 270–276 (1989)

ARTICLE I
NAME AND PURPOSE

Section 1. The name of this corporation shall be The New England Botanical Club, Incorporated.

Section 2. Its purpose shall be to promote the dissemination of local and general botanical information.

Section 3. The Club shall be organized and operated exclusively for its educational and scientific purposes. No part of the property or net earnings of the Club shall inure to the benefit of any individual; and no part of the property of the Club shall be used directly or indirectly in carrying on propaganda, nor shall any substantial part of the activities of the Club consist of the carrying on of propaganda or otherwise attempting to influence legislation. The Club shall not participate in, nor intervene in, any political campaign on behalf of any candidate for public office, nor shall it publish or distribute any statements with respect thereto.

ARTICLE II
SEAL

The seal of the Club shall, subject to alteration by the Council, consist of a flat-faced circular die with the words "Massachusetts," "Organized 1895, Incorporated 1920," and the name of the corporation cut or engraved thereon.

ARTICLE III
OFFICERS AND COUNCILLORS

Section 1. The officers of the Club shall be a President, a Vice-President, a Corresponding Secretary, a Recording Secretary, a Treasurer, a Curator of Vascular Plants, an Assistant Curator of Vascular Plants, a Curator of Nonvascular Plants, and a Librarian. There shall be five councillors, one of whom may be a student and one of whom may be the immediately preceding President.

Section 2. All officers and councillors shall be elected by ballot by a majority of those members voting at the Annual Meeting of the Club, and, except in the case of death, resignation, or removal, each officer shall hold office until the next Annual Meeting or until a successor is elected. Voting by proxy shall not be allowed.

Section 3. If the office of any officer or councillor becomes vacant by reason of death, resignation, or removal, the Council may appoint a successor who shall hold the office until the next Annual Meeting or until a successor is elected.

ARTICLE IV
COUNCIL

Section 1. The Council shall consist of the above-named officers and councillors, the Associate Curator and the Editor-in-Chief of *Rhodora*. The Associate Curator shall be appointed by the Council to serve as a liaison with the Harvard University Herbaria. The Editor-in-Chief of *Rhodora* shall be appointed by the Council.

Section 2. The Council, a majority of which shall constitute a quorum, shall have the management and control of the Club and of all its property and affairs and shall direct the expenditure of its funds.

Section 3. The Council shall authorize and approve, except as the Council may generally or in particular cases authorize the execution thereof in some other manner, all deeds, transfers, and contracts; and all bonds or notes made or endorsed by the Club shall be signed by the Treasurer and countersigned by the President or the Vice-President. All deeds, transfers, and contracts shall be signed by the President or in the President's absence by the Vice-President.

Section 4. The Council may appoint and remove such other officers or agents as it may from time to time determine. It may appoint committees as it sees fit and may delegate to these committees such powers for such terms as the Council deems best, subject to the power of the Council to revoke any such appointment at any time.

Section 5. The Council shall have the books and accounts of the Treasurer audited at least once a year by an external Auditor.

ARTICLE V
DUTIES OF THE OFFICERS

Section 1. The President and Vice-President shall perform the usual duties of their offices.

Section 2. The Curator of Vascular Plants and the Curator of Nonvascular Plants shall have charge of the botanical collections of the Club. The Assistant Curator of Vascular Plants (or in that officer's absence, the Associate Curator) shall perform the duties of the Curator of Vascular Plants in the Curator's absence.

Section 3. The Librarian shall have charge of the books and manuscripts of the Club.

Section 4. The Corresponding Secretary shall give notices of all meetings of the Club and of the Council, and shall conduct the correspondence of the Club.

Section 5. The Recording Secretary, who shall be the Clerk, shall be sworn before entering upon the duties of the Recording Secretary, and as such shall keep the minutes of all meetings of the Club and of the Council and such other records as the Council may direct.

Section 6. The Treasurer shall, subject to the orders and supervision of the Council, collect and disburse the funds of the Club, and for this purpose shall have power to endorse for deposit or collection, all funds, checks, drafts, etc. payable to the corporation or its order. The Treasurer shall keep, or cause to be kept, accurate books of account, and shall make a report of the financial condition of the Club at each Annual Meeting, and at such other times as the Council may request.

ARTICLE VI
NOMINATING COMMITTEE

On or before December fifteenth of each year, the President shall appoint a committee of three members—who shall not be officers—to nominate officers for the ensuing year. The report of this committee, which shall be filed with the Corresponding Secretary and open to inspection at least three weeks prior to the Annual Meeting, shall be incorporated in the call for the Annual Meeting.

Nothing herein shall restrict the right of members to offer nominations from the floor provided a notice listing such nominees and signed by not less than three members shall be filed with the Corresponding Secretary not later than ten days prior to the date of the meeting.

ARTICLE VII
MEMBERSHIP AND DUES

Section 1. Membership inquiries and resignations may be made to the Corresponding Secretary.

Section 2. Upon payment of annual dues, all members shall have voting privileges and shall receive *Rhodora*.

Section 3. Dues and subscription price of *Rhodora* shall be determined at appropriate intervals by the Council.

Section 4. Annual dues shall be payable the first of January. Any member whose dues remain unpaid for more than three months after same become payable shall cease to receive *Rhodora*. The membership of any member shall automatically terminate if dues or other indebtedness to the Club remain unpaid for thirteen months after same become payable.

Section 5. In the event of the death, resignation, or other termination of the membership of a member, all privileges shall cease. Dues will not be prorated and reimbursed except in instances where more than one year's membership remains.

ARTICLE VIII
MEETINGS OF THE CLUB

Section 1. The Annual Meeting of the Club shall be held on the first Friday in March of each year, unless otherwise ordered by the Council, and regular meetings shall be held monthly, except during July, August, and September at such times as the Council may determine. If the Annual Meeting is omitted by oversight or otherwise on the day herein provided therefor, a special meeting may be held in place thereof, and any business transacted or elections held at such meeting shall have the same effect as though transacted or held at the Annual Meeting.

Section 2. Special meetings may be called by the President or by vote of the Council or by written request of any ten members given to the Corresponding Secretary. Every such call shall state the object for which the meeting is being called.

Section 3. Notice of all meetings shall be distributed at least seven days before such meetings.

Section 4. At any meeting of the Club, fifteen members shall constitute a quorum for the transaction of business, except the amendment of the Bylaws.

ARTICLE IX
AMENDMENTS OF THE BYLAWS

These Bylaws may be altered, amended, or repealed in the following manner: at any Annual, regular, or special meeting of the Club by a two-thirds vote of the members present and voting,

provided that at least thirty members or two-thirds of the membership (whichever is the smaller number) are present at the meeting, and that the subject matter of the proposed alteration, amendment, or repeal has been given in the call for the meeting at which the alteration, amendment, or repeal is to be considered.

ARTICLE X
FISCAL YEAR

The fiscal year of the Club shall end on the thirty-first day of December in each year.

ARTICLE XI
DISSOLUTION

Should the Club be dissolved for any reason, the officers shall, after paying or making provision for payment of all the liabilities of the corporation, distribute all assets, including all accrued income, to one or more scientific, educational and/or literary organizations under Section 501(c)(3) of the Internal Revenue Code of 1986 (or the corresponding provision of any subsequent United States Internal Revenue Law).

THE NEW ENGLAND BOTANICAL CLUB

Elected Officers and Council Members for 1996–1997:

President: W. Donald Hudson, Jr., Chewonki Foundation, RR 2, Box 1200, Wiscasset, ME 04578

Vice-President (and Program Chair): David S. Conant, Department of Natural Sciences, Lyndon State College, Lyndonville, VT 05851

Corresponding Secretary: Nancy M. Eyster-Smith, Department of Natural Sciences, Bentley College, Waltham, MA 02154-4705

Treasurer: Harold G. Brotzman, Box 9092, Department of Biology, North Adams State College, North Adams, MA 01247-4100

Recording Secretary: Lisa A. Standley

Curator of Vascular Plants: Raymond Angelo

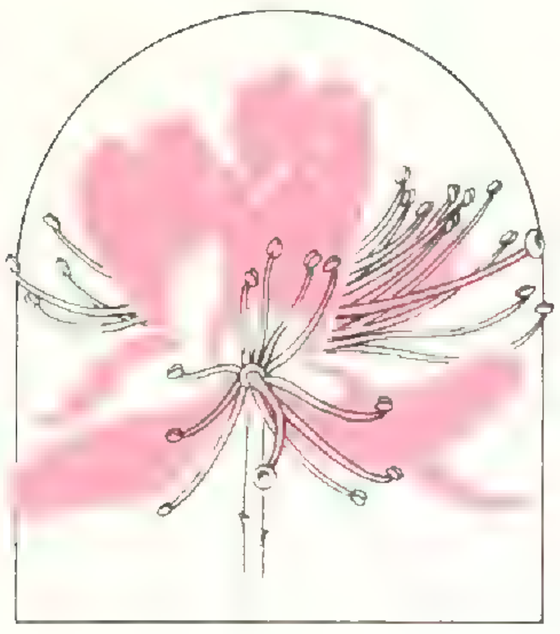
Assistant Curator of Vascular Plants: Pamela B. Weatherbee

Curator of Nonvascular Plants: Anna M. Reid

Librarian: Paul Somers

Councillors: C. Barre Hellquist (Past President)
Garrett E. Crow 1997
Matthew Hickler (Graduate Student Member) 1997
Edward Hehre, Jr. 1998
Michael J. Donoghue 1999

Appointed Councillors:
David E. Boufford, Associate Curator
Janet R. Sullivan, Editor-in-Chief, *Rhodora*



RHODORA

The Journal of the
New England Botanical Club

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Vol. 98 **Summer, 1996** **No. 895**

Issued: July 7, 1997

The New England Botanical Club, Inc.

22 Divinity Avenue, Cambridge, Massachusetts 02138

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RHODORA (ISSN 0035-4902). Published four times a year (January, April, July, and October) by The New England Botanical Club, 810 East 10th St., Lawrence, KS 66044 and printed by Allen Press, Inc., 1041 New Hampshire St., Lawrence, KS 66044-0368. Periodicals postage paid at Lawrence, KS. POSTMASTER: Send address changes to RHODORA, P.O. Box 1897, Lawrence, KS 66044-8897.

RHODORA is a journal of botany devoted primarily to the flora of North America. Monographs or scientific papers concerned with systematics, floristics, ecology, paleobotany, or conservation biology of the flora of North America or floristically related areas will be considered.

SUBSCRIPTIONS: $75 per calendar year, net, postpaid, in funds payable at par in United States currency. Remittances payable to RHODORA. Send to RHODORA, P.O. Box 1897, Lawrence, KS 66044-8897.

MEMBERSHIPS: Regular $35; Family $45; Student $25. Application form printed herein.

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ADDRESS CHANGES: In order to receive the next number of RHODORA, changes must be received by the business office prior to the first day of January, April, July, or October.

INFORMATION FOR CONTRIBUTORS: See contents. Submit manuscripts to the Editor-in-Chief.

♾ This paper meets the requirements of ANSI/NISO Z39.48-1992 (Permanence of Paper).

RHODORA, Vol. 98, No. 895, pp. 233–361, 1996

FLORA CONSERVANDA: NEW ENGLAND. THE NEW ENGLAND PLANT CONSERVATION PROGRAM (NEPCoP) LIST OF PLANTS IN NEED OF CONSERVATION

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ABSTRACT. The New England Plant Conservation Program (NEPCoP) regional rare plant list, "*Flora Conservanda:* New England," identifies vascular plant taxa in need of regional conservation. In 1993, NEPCoP established a Listing Committee consisting of representatives of each of the six state Natural Heritage Programs (NHPs) and additional scientists. The most current information on the rare vascular flora of each state, stored at the respective NHPs, was used as the basis of the NEPCoP List. The List comprises 576 taxa in five divisions: Division 1—Globally Rare Taxa (57 taxa); Division 2—Regionally Rare Taxa (273 taxa); Division 3—Locally Rare Taxa (75 taxa); Division 4—Historic Taxa (55 taxa); and Division Indeterminate (IND.)—116 taxa.

Key Words: NEPCoP, New England, conservation, endangered species, plants, regional plant program, *Flora Conservanda,* regional conservation list

The New England Plant Conservation Program (NEPCoP), a voluntary collaboration of botanists, state and federal agencies, and conservation organizations in each of the New England states, was initiated by the New England Wild Flower Society (NEWFS) in 1991. The goals of NEPCoP are to prevent the extirpation and promote the recovery of the endangered flora of New England (New England Wild Flower Society 1992). The Program provides regional coordination for state-based plant conservation efforts to make best use of limited resources. NEPCoP was initiated for several reasons: 1) on a global and regional scale, plant species are under extreme threat; 2) a lack of public awareness concerning the importance of plants has contributed to plant endangerment; and 3) there is inadequate support for plant conservation activities from both the public and private sectors.

The Program is administered by a Regional Advisory Council, Task Forces in the six New England states, and NEWFS. The Council, consisting of representatives from each state Task Force, members of the Board of Trustees at NEWFS, and other representatives from other conservation organizations, convenes as necessary to monitor and advise the overall Program. The Council sets policy for regional plant conservation, oversees development of the "*Flora Conservanda:* New England," and selects priority species for conservation action throughout the region.

State Task Forces are the heart of the program. Each Task Force, comprised of individuals knowledgeable of the state's flora, selects populations of priority species to be surveyed and di-

rects conservation actions. The Task Forces meet at least once annually to discuss progress and set conservation agendas.

NEPCoP integrates *in situ* with *ex situ* conservation methods.

In situ methods. The best method for conserving plants is to protect the habitats where wild populations occur. Protection of land in itself, however, may not ensure the perpetuation of plant populations. Changes in habitats over time may necessitate management in order to preserve rare species. Members of each state's Task Force survey occurrences of rare plants, identify threats, and make suggestions for future management.

Ex situ methods. As a complement to protection and management of wild plant populations, plant propagules are collected from selected populations for seed banking, research, and public education. A seed bank of endangered species has been established at Garden in the Woods, the botanic garden of the New England Wild Flower Society in Framingham, Massachusetts, as a backup in the event of catastrophic loss in the wild. Seeds are collected from vulnerable populations of priority species as determined by each state Task Force. The number of populations sampled depends on many factors including the size and number of occurrences within each state, the type of land ownership, and each species' potential for successful seed banking.

An important part of the seed banking process is research on the propagation and cultivation of rare plant species. As seeds are tested for banking, the optimal propagation methods for each species are researched, and any plants produced can be made available for research. Most importantly, this propagation research provides information that can be applied to management of wild populations as well as propagules for reintroduction if deemed necessary. In addition, plants obtained through propagation research become part of the collection of the New England Garden of Rare and Endangered Plants, also maintained at the Garden in the Woods. This collection is an educational display for the public and a genetic resource for conservation and research.

Realizing that continual monitoring of all regional rare plant populations will not be accomplished by the currently limited

number of professionals, NEPCoP has instituted a pilot program of Volunteer Rare Plant Monitors. This program, at present in Massachusetts only, trains volunteers to survey rare plant occurrences. The initial results have been impressive and the expansion of this program both within Massachusetts and throughout the region is anticipated.

New England states have had a strong interest in conservation of the native flora for many years. Connecticut passed a law in 1868 to protect the Hartford Fern, *Lygodium palmatum* (Mehrhoff 1980), which may be the earliest legal attempt at conservation of plants for aesthetic interest rather than for utilitarian reasons.

The New England Botanical Club (NEBC) formed its first conservation committee, the Natural Areas Criteria Committee, in 1971. The Endangered Species Committee was an offshoot of this initiative and in 1975 began the preparation of individual state reports of rare and endangered vascular plants with the support of the U.S. Fish and Wildlife Service. These reports included: Maine (Eastman 1978), New Hampshire (Storks and Crow 1978), Vermont (Countryman 1978), Massachusetts (Coddington and Field 1978), Rhode Island (Church and Champlin 1978), and Connecticut (Mehrhoff 1978).

These state lists served as a basis for the NEBC regional list (Crow et al. 1981). This regional list included 479 taxa, the majority of which were either "E/T" (Endangered/Threatened—337 taxa) or "R" (Rare—133 taxa). Taxa designated as "E/T" were documented from 10 or fewer *towns* and "R" were documented from 10 to 20 *towns*. In addition, other designations, such as federal status or consideration, were included. Occurrences for each taxon within each state were noted by a variety of designations.

The 1981 list was "based, in large part, on historical records documented by specimens in herbaria" (Crow et al. 1981). Prior to this publication there had been little concerted effort to collect or document regionally rare taxa, and the NEBC committee was faced with the daunting task of determining which taxa were rare throughout the region. This was accomplished using the first-hand knowledge of state experts, information culled from the literature, and selective checking of herbarium records. Often, there was no way to ascertain the current status of a taxon with only specimens and literature.

Beginning in 1978, The Nature Conservancy facilitated the es-

tablishment of state Natural Heritage Programs (or their equivalent) in each of the New England states. Similar programs already existed in some states. These Programs undertook and encouraged intensive field work in their respective states, resulting in many new or updated records for rare taxa. Because of this field work, many individual state lists were refined to reflect the more current status information. Some taxa remained elusive or showed a decline while others were shown to be more common and were removed from state lists. During the 1980s, most New England states formulated state laws regarding rare or endangered plants (see Appendix I for current state laws).

DEVELOPMENT OF THE NEPCOP "*FLORA CONSERVANDA:* NEW ENGLAND"

Purposes. In order to guide regional efforts, NEPCoP first needed to identify species and populations of regional conservation concern. Towards this end, a Listing Committee of the Regional Advisory Council was formed to develop and maintain a regional list of plants known as "*Flora Conservanda:* New England" (often referred to as the NEPCoP List).

In addition to identifying taxa and populations of regional conservation concern, the NEPCoP List is intended to promote the resolution of nomenclatural and taxonomic vagaries or problems and to suggest priorities for protection at both the species and population levels. It is hoped that it will aid the development of priorities for research, protection, and recovery on a regional basis, and help states to coordinate their individual species conservation efforts. The NEPCoP List differs from state and federal lists in two ways: first, it provides a regional (New England) perspective on the conservation status of each taxon; second, it has no legal standing. (Legal protection or status, however, may be afforded a taxon within an individual state or through the federal government.)

The NEPCoP List focuses on taxa that are globally and regionally rare (Divisions 1 and 2). It also identifies taxa that may be common throughout a significant portion of the region, but that have occurrences of conservation importance owing to their biological, ecological or (potential) genetic significance (Division 3). It further identifies taxa which are considered historic in the region (Division 4) as well as those which may be rare throughout

New England, but for which taxonomic or distributional information is insufficient to determine status (Division IND.).

The List is intended to be useful to the following: 1) NEPCoP State Task Forces in selecting species for conservation; 2) scientists in focusing efforts on critical species; 3) federal, state, and local government agencies and private land conservation organizations in identifying the most important taxa to protect and manage within the region; and 4) the public in supporting conservation efforts.

Methods. "*Flora Conservanda:* New England" was developed by a Listing Committee consisting of representatives of each of the six state Natural Heritage Programs (NHPs) and several other botanists familiar with the regional flora. The most current information regarding the distribution and status of the rare vascular plants of each state is stored in their respective NHPs in a comprehensive Biological and Conservation Database (BCD) developed by The Nature Conservancy. The records maintained in the state databases constituted the basis for developing "*Flora Conservanda:* New England."

Each NHP monitors (tracks) a large number of species considered to be rare within its state. The initial compilation of the six state lists combined with the NEBC list (Crow et al. 1981) resulted in the identification of more than 1100 taxa. Approximately 200 additional taxa were reviewed by the Committee, as well. By developing strict definitions for the inclusion of a taxon within one of the five Divisions of "*Flora Conservanda:* New England," the Committee succeeded in identifying 576 taxa of highest regional concern out of a total of approximately 3024 indigenous or partly indigenous taxa in New England (Seymour 1969).

Determination for listing is based on the number of Element Occurrences (EO) within each state. The term was devised by The Nature Conservancy and is used in conservation as an alternative to "population." Populations of organisms often are difficult to delineate without intensive research, and use of the term "population" often implies that its limits are known. Somewhat broader in scope, an occurrence is defined as follows: "For species. . . . element occurrences represent the full occupied habitat (or previously occupied habitat) that contributes, or potentially contributes, to the persistence of the species at that location. EOs are separated from each other by substantial barriers to movement

or dispersal, or by specific distances defined for each element across either unsuitable, or suitable but apparently unoccupied habitat." (The Nature Conservancy, Conservation Science Division, in association with the Network of Natural Heritage Programs and Conservation Data Centers 1997).

The state NHPs have made every attempt to verify the records included in the NEPCoP List. In some cases, certain occurrences were revisited during the development of the List with the intent of assessing current status and updating existing NHP files.

Herbarium specimens have been crucial to the preparation of "*Flora Conservanda:* New England" as vouchered records of occurrences included in the List. An herbarium specimen collected in New England exists for every taxon included in the NEPCoP List. These specimens have helped clarify taxonomic and distributional issues, and they exist as a permanent record of a plant's existence at a particular site and time.

All data included within "*Flora Conservanda:* New England" are current as of December 1995; in some cases, discoveries made during the 1996 field season are included. Occurrence numbers included in Divisions 1, 2, and 3 and IND. are for occurrences verified as extant since 1970. The database used for "*Flora Conservanda:* New England" was developed by BG-BASE, Inc., Holden Arboretum, Kirtland, Ohio.

The List is dynamic, and it is the intent of the Regional Advisory Council to update it every five years. To facilitate this process, the state NHPs are actively seeking information on the status of listed taxa. Corrections, comments, and additional information pertaining to any taxon already listed, or warranting listing, are solicited by the NHPs and NEPCoP.

Nomenclature. Precise nomenclature for each taxon was of paramount concern for the Listing Committee because of the diverse audience of anticipated users and the plethora of potential identification manuals and field guides. No single reference is used by botanists, conservationists, government officials, and wildflower enthusiasts throughout New England. The late Arthur Cronquist's recent manual (Gleason and Cronquist 1991) likely will become a standard reference, but nomenclature in this manual does not in all instances match names used in some recent state checklists, i.e., "Checklist of the Vascular Plants of Maine" (Campbell et al. 1995). Furthermore, some state Natural Heritage

Programs use names suggested by the national office of The Nature Conservancy which follows Kartesz (1994).

NEPCoP's Regional Advisory Committee adopted the following policy for nomenclature (New England Wild Flower Society 1992):

1) The primary source is to be the *Flora of North America* (FNA), a multi-year, multi-volume endeavor. As of this writing, only the volume covering the Pteridophyta and Pinophyta has been published (Flora of North America Editorial Committee 1993). A second volume, covering the Magnoliidae and Hamamelidae of Cronquist (1981), is in press.

2) Secondary sources are to be the authors of taxonomic treatments for future volumes of FNA. Although changes in nomenclature are possible through the editing and review phases of the preparation of each volume, it is expected that most of these names are likely to pass the rigorous review of the FNA Editorial Committee and their reviewers. Consequently, for difficult taxonomic groups, every effort was made to contact authors of future treatments of FNA (see Acknowledgments). In some instances, however, authors have not yet been selected by the FNA editorial committee. When the nomenclature to be used in future FNA treatments coincided with that of a published source, the existing publication is cited as the primary source of the name.

3) The tertiary source for nomenclature is Gleason and Cronquist (1991), the most recent floristic manual available for New England. Although most of this work provides an acceptable taxonomic reference, treatments such as those for *Viola* and *Scirpus* (sensu lato) pose problems. *Viola novae-angliae* and *Scirpus ancistrochaetus,* acknowledged by other sources including the U.S. Fish and Wildlife Service, have been included in other wide-ranging, polymorphic taxa in this manual. Similarly, other treatments do not follow current thought: e.g., the use of *Lycopodium* instead of the separate genera *Lycopodium, Diphasiastrum, Huperzia, Lycopodiella,* and *Pseudolycopodiella* (as cited by Flora of North America Editorial Committee 1993) or *Habenaria* as opposed to the currently widely accepted *Platanthera.*

Three important references were not chosen as standards for nomenclature, although they are often cited in the NEPCoP List. Merritt Lyndon Fernald's *Gray's Manual of Botany* (Fernald 1950), although still used by many field botanists because of its thoroughness, is not current in nomenclature, taxonomy, or de-

scriptions of plant distribution. *The Flora of New England* (Seymour 1969) was derived primarily from the study of herbarium specimens, and although it is extremely helpful in visualizing plant distribution, it essentially follows the taxonomic treatments found in *Gray's Manual of Botany* (Fernald 1950). *A Synonymized Checklist of the Vascular Flora of the United States, Canada, and Greenland* (Kartesz 1994) had not been published at the time this project was started. Moreover, most of the intended audience for the NEPCoP List is not likely to have easy access to this work, which does not contain keys to aid in field identification. Fortunately, many of the names used in the NEPCoP List are the same as in Kartesz (1994), which is an especially valuable reference because of its nomenclatural accuracy.

To increase the utility of "*Flora Conservanda:* New England," identification manuals and widely reviewed regional floristic treatments are cited as the source of either the primary name or synonym in order to facilitate field identification. Either the primary name or its synonym(s) usually can be found in at least one manual that contains a key. Each entry includes preferred synonyms used by one or more of the six New England states. The synonymy is not intended to be complete. An Index to all names and synonyms used in the NEPCoP List follows the Appendices.

FORMAT OF THE NEPCOP LIST

Divisions of the List. "*Flora Conservanda:* New England" is divided into five divisions:

Division 1: Globally Rare Taxa occurring in New England. Taxa included in this Division are listed as Globally Rare (G1 through G3 or T1 through T3) by The Nature Conservancy (adapted from Master 1991 and The Nature Conservancy 1996; see Global Rank—GRank—explanations under Notes below or in Appendix II). Usually only a few occurrences of these taxa exist within our region, but New England does contain the majority of occurrences for a few of these highly ranked taxa. In some cases, taxa with GRanks that normally would place them in this division have taxonomic or other issues that make their current status in New England unclear, and the majority of these taxa have been placed in other divisions. GRanks for taxa in this division appear in the Notes section under each taxon in the list.

Division 2: Regionally Rare Taxa. These taxa have fewer than

20 current occurrences (seen since 1970) within New England. This division includes taxa which are rare throughout their range in all of New England as well as taxa that reach the edge of their distributional range in our region. It is important to conserve these edge-of-range occurrences as part of New England's natural heritage as well as to avoid further shrinkage of these species' entire ranges. A taxon with more than 20 occurrences in New England might also be included in Division 2 if a substantial number of occurrences contain small numbers of individuals making them more vulnerable to extirpation. These taxa are denoted as 2(a). All taxa in Division 2 have GRanks of G4 or G5 (see Appendix II for definitions).

Division 3: Locally Rare Taxa. These taxa may be common in part of New England, but have one or more occurrences of biological, ecological, or possible genetic significance. For this division, only selected *occurrences in a particular state* are listed, not the entire taxon's occurrences throughout New England. A taxon may be listed as Division 3 in one or more states (designated by an *), but is not considered to be regionally rare. An occurrence could be designated as Division 3 *in a state* if:

1. The occurrence is disjunct to such a degree that genetic isolation is likely (i.e., separated from other populations by more than 50 miles).
2. An occurrence represents an ecological anomaly for the taxon within the New England region (for example, an acid bog occurrence of a species that normally grows under calcareous conditions).
3. A significant number of a taxon's occurrences have demonstrably declined within the state (in which case the entire state's occurrences are considered to be in Division 3).

Note: The current distribution immediately outside New England, i.e., New York state and the Canadian provinces of Quebec and New Brunswick, was also considered in determination of disjunction. For example, an occurrence of a taxon in northern Maine that is disjunct from southern New England occurrences would not qualify for Division 3 if it was within 50 miles of an occurrence in New Brunswick or Quebec.

Division 4: Historic Taxa. Taxa that once existed in New England, but that have not been seen since 1970. The purpose of this division is to generate interest in re-locating these taxa if they

still exist and to illustrate the level at which species have been lost from the region.

Division Indeterminate (IND.): Indeterminate Taxa. These taxa are under review for inclusion in one of the above divisions, but issues of taxonomy (at least for New England occurrences), nomenclature, or status in the wild are not clearly understood. The purpose of this division is to stimulate interest in taxonomic research and/or field surveys for these taxa.

Structure of the List. The NEPCoP List is divided into 8 columns. Taxa are listed alphabetically by family, alphabetically by genus within each family, and alphabetically by species within each genus.

Column 1 contains the name of the taxon, the author, and source of the name (number in parentheses). Synonyms are listed in italics below the taxon with the source of the name (number in parentheses) and the state using the synonym [in brackets]. For example:

ALISMATACEAE
Echinodorus tenellus (Martius) Buchenau (11)
Echinodorus parvulus (15) [MA]
Echinodorus tenellus var. *parvulus* (14) [CT]

Column 2, with the heading DIV, contains the NEPCoP Division. This may be 1,2,3*,4, or IND. (see Divisions of the List above).

Columns 3–8 contain State Data (next six columns under abbreviated names of the states). Under each state are three blocks separated by vertical bars. If no data are present in any of the three blocks the taxon is not known to occur in that state. An asterisk is used when a state has occurrences of a taxon listed in Division 3.

The first block contains the number of currently extant (seen since 1970) occurrences of the taxon in that state. If the number of occurrences is more than 20, but not precisely known, a "+" is placed in this block. Typically, taxa with a "+" are considered common in the state and thus are not tracked by the NHP. Occurrences discovered or known prior to 1970, but not verified since 1970, are not considered current (but could possibly still be extant). If the taxon once was native in a state, but is not currently

considered extant (not seen since 1970), it is designated with "H."

The second block contains the official State endangerment status of the taxon (Endangered, Threatened, etc.). Depending on the state, this status may have a legal designation. Since the same code may have different meanings in different states, refer to the State Status Codes in Appendix I for the definition of these terms in each state. Please note that the codes used by some states have been modified in this List for consistency and clarity.

The third block contains the State Rank (SRank) as defined by The Nature Conservancy (adapted from Master 1991 and The Nature Conservancy 1996). This generalized ranking is based on the number of individuals, number of occurrences, and other factors contributing to the vulnerability of a taxon within each state. The SRank codes used in this List are cited in Appendix III, but the most commonly used codes are:

S1 = generally 1–5 occurrences in the state.
S2 = generally 6–20 occurrences in the state.
S3 = generally 21–100 occurrences in the state.
S4 = generally 101–1000 occurrences in the state.
SE = an exotic (non-native) species in the state.
SH = Historic—occurred historically (as a native species) in the state, but is not currently known to be extant in the state.
SU = State Unrankable—the status of the taxon is not known. In many instances where a taxon is ranked "SU," the number of occurrences of the taxon (if any) is not known.
SX = taxon is presumed extirpated in the state.

Notes under a taxon. Explanatory notes and additional information are added where necessary beneath the state data blocks. Included in this section is the taxon's Global Ranking or GRank. A species is given a Global Rank identified by a G followed by a number or symbol, and a subspecies or variety has a T followed by a number or symbol. (For example, *Eupatorium leucolepis* var. *novae-angliae* has a GRank of G5T1, which means that the species is secure globally, G5, but that the variety is critically imperiled globally, T1). In this List, GRanks are given only for those taxa with a GRank containing G1, G2, G3 or T1, T2, T3 (or a combination thereof). If no GRank is given, the taxon has a

GRank of G4 or G5. See Appendix II for a complete list of GRank codes used in this List. Most commonly used ranks are:

G1 = Critically imperiled globally (typically 5 or fewer occurrences globally).
G2 = Imperiled globally (typically 6 to 20 occurrences globally).
G3 = rare or uncommon but not imperiled globally (typically 21 to 100 occurrences globally).
G#G# = Numeric range rank: A range spanning two or more of the numeric ranks. Denotes range of uncertainty about the exact rarity (for example—G2G3).
G? = Unranked, Element is not yet ranked globally.
G#T# = for infraspecific taxa: The GRank applies to the full species; T = Taxonomic subdivision and the rank applies to the subspecies or variety.
T1, or T2, or T3—same definitions as G1, G2, G3, but refers to a subspecies or variety.
T#T# = Numeric range rank: A range spanning two or more of the numeric ranks for a variety or subspecies. Denotes range of uncertainty about the exact rarity of variety or subspecies (for example—G5T2T3).
? = Inexact or uncertain (for example G3? or G5T3? means that the numeric ranking is uncertain).
Q = Questionable taxonomy: taxonomic status is questionable; numeric rank may change with taxonomy (for example, G4T3Q means that the taxonomy, in this case of the subspecies or variety, is questionable).

Also contained in the Notes section are codes used by the U.S. Fish and Wildlife Service (USFWS) under the provisions of the U.S. Endangered Species Act of 1973 (the Act), as amended. If a taxon is listed as Endangered or Threatened under the Act, LE (Listed Endangered) or LT (Listed Threatened) will appear in this column. Other designations include C2 for taxa that formerly were considered as candidate species for listing under the Act. This category has been discontinued under a notice of final decision published in 1996 (U.S. Fish and Wildlife Service 1996). Also included are codes for taxa no longer under consideration by the USFWS. These designations (3A, 3B, and 3C) have been

discontinued also. See Appendix IV for a complete listing of Federal codes used in this List.

DISCUSSION

Lists of this nature frequently point to the need for additional work. The process of compiling "*Flora Conservanda:* New England" demonstrated to the Listing Committee the obvious need for protection and management for many taxa and their occurrences. The process also emphasized the need for additional field work to gather data on occurrence sizes and distributions. Unfortunately there are too few knowledgeable field botanists to cover the full extent of rare plants in New England. Volunteers must be sought and trained to help with this task. Basic botanical inventory is essential for an accurate understanding of the true rarity of listed taxa as well as for interpreting population trends over time.

Two areas where additional work is needed became apparent as the Listing Committee worked on "*Flora Conservanda:* New England." First, many taxonomic questions concerning the New England flora remain unanswered; many of these center on infraspecific taxa. Entities observable in the field (and often named by New England's most famous student of its flora—Merritt L. Fernald) should be studied using current tools and methodologies in order to resolve taxonomic issues. For example, is *Eupatorium perfoliatum* var. *colpophilum* a "good" variety or an ecomorph? Is *Cardamine longii* a "good" species? A particularly perplexing taxonomic issue involves *Bidens heterodoxa.* Cronquist (Gleason and Cronquist 1991) mentions this taxon (under *B. connata*), but does not include it as a distinct species as he does for *B. eatonii* or *B. hyperborea* (which are present on the NEPCoP List). He states that *B. heterodoxa* consists of a series of rare and local populations. Should *B. heterodoxa* be afforded the same protection as listed taxa? The resolution of these questions is not merely an academic exercise but helps to assure the best use of limited conservation resources.

Similarly, hybrids and the hybrid nature of some taxa need clarification. Is a hybrid sterile or fertile? Do both sterile and fertile hybrids deserve protection? Some scientists argue for protection of sterile hybrids because of the possibility of ploidy shift that will allow a polyploid to become fertile. In the NEPCoP List

we have included hybrid taxa considered to be nothotaxa (a nomenclatural term that defines species of hybrid origin whose names include all the offspring including backcrosses). We also have listed sterile hybrids in some instances in order to raise the issue of their protection.

Equally important is the need for nomenclatural study. Often, the Committee was faced with a choice of names for a given taxon. Frequently exacerbating this problem was the issue of unclear synonymy. Moreover, different manuals and reference works sometimes use different names for what appears to be the same taxon.

Occasionally, both taxonomy and nomenclature were unclear. For example, the taxon called *Puccinellia tenella* ssp. *alascana* is an extreme example of a taxon that was placed in the Division IND. (Indeterminate) because of unclear nomenclature and taxonomic circumscriptions. Equally confusing are some taxa in the genera *Panicum* and *Viola.*

The Listing Committee hopes that by focusing attention on these issues, clarification by the scientific community will follow. Ideally, many of the issues regarding field status, taxonomy, and nomenclature that are highlighted by the publication of "*Flora Conservanda:* New England" will have been addressed by scientists before the next iteration of the List, anticipated in the year 2002. The ongoing publication of *Flora of North America* also will provide guidance.

The NEPCoP List contains 576 taxa in the following divisions: Div. 1—Globally rare = 57 taxa; Div. 2—Regionally rare = 273 taxa; Div. 3—Locally rare = 75 taxa; Div. 4—Historic = 55 taxa; and Div. IND.—Indeterminate = 116 taxa.

In comparison, the NEBC regional list (Crow et al. 1981) included 479 taxa, the majority of which were designated "E/T" (Endangered/Threatened—337 taxa) or "R" (Rare—133 taxa). Taxa designated as "E/T" were documented from 10 or fewer *towns* and "R" were documented from 10 to 20 *towns.* Because different criteria were used to create the 1981 NEBC list and the NEPCoP List, comparisons are difficult. The two major differences are:

1) The NEBC list used *towns* as a criterion in contrast with current *occurrences* in the NEPCoP List. Theoretically, a taxon could appear on the NEBC list because it was found in fewer than 20 towns in New England, but since there could be more

than one occurrence in a town it theoretically might not appear on the NEPCoP List in Division 1 or Division 2. The taxon could, however, still appear in another NEPCoP division (i.e., Division 3 or Division IND.).

2) The NEPCoP List uses *current* occurrence data. Since 1970 was used as the cutoff date for current occurrences in the NEPCoP List, only occurrences actually verified since that date have been included. In contrast, the NEBC list used herbarium specimens as the primary source for deriving the list (Crow et al. 1981). Although some field investigations were conducted, many of the specimens which counted towards the inclusion (or exclusion) of a taxon in the NEBC list were collected prior to 1970. These historic (by NEPCoP standards) occurrences were not considered as currently extant in the NEPCoP evaluation of the region's rare flora. These occurrences either have been re-located (and thus are considered current) or considered not to be extant.

Discounting synonymy, as well as taxonomic and nomenclatural changes, there are 221 taxa on the NEPCoP List that did not appear on the NEBC list. Seventy-three of these appear in Division 1 or Division 2, indicating that these taxa currently appear to be more rare than previously thought. Seventy-eight taxa on the NEPCoP List as Division IND. (Indeterminate) did not appear on the NEBC list. This shows, perhaps, that as our knowledge about the rarity of the New England flora has increased, so has the realization that there are many taxa whose field status or taxonomy (at least in New England) is still unclear. Also, there are 14 taxa on the NEPCoP List in Division 4 as Historic in New England that did not appear on the NEBC list. Their appearance on the NEPCoP List is partly a function of the 1970 cutoff date, but also reflects our increased knowledge of the flora through field work of the state Heritage Programs, The Nature Conservancy, NEPCoP, NEBC, and other organizations. On the other hand, discounting synonymy as well as nomenclatural and taxonomic changes, there are 38 taxa on the NEBC list that do not appear on the NEPCoP List. Considered more common by NEPCoP standards, their exclusion is again the result of increased field work and data collection.

RECOMMENDATIONS

Because of differences in the criteria used to create the NEPCoP and NEBC lists, we cannot state with certainty that rare

plant species have declined in New England in the interim between the publication of the two lists. While comparisons are difficult, anecdotal information and field observations suggest a decline in the number of current occurrences for many taxa. This trend is substantiated by a number of occurrences that have not been re-located despite intensive field searches.

The publication of "*Flora Conservanda:* New England" provides baseline data to judge the future status of rare species. In order to protect New England's flora the cooperation of many individuals and organizations will be necessary. The NEPCoP List is a good example of such cooperation that combines institutional resources and interests to further conservation goals. NEPCoP recommends that the rare taxa (or occurrences, in the case of Division 3 taxa) be monitored at regular intervals as part of a regional conservation plan. Such a plan would also include habitat protection, management of existing occurrences, seed banking, and enhancement, reintroduction, or introduction if deemed necessary. Field investigations and/or taxonomic study of Indeterminate taxa (Division IND.) are needed to determine the conservation status of more than 100 taxa in this Division. It is hoped that the NEPCoP List will focus research attention on these problematic taxa.

FLORA CONSERVANDA: NEW ENGLAND

NAME	Div	ME	NH	VT	MA	RI	CT
ACANTHACEAE							
Justicia americana (L.) M.Vahl (14)	4	||||	||||	|H| |SH|	||||	||||	|||
ADIANTACEAE							
Adiantum aleuticum (Ruprecht) Paris (12)	2	|1|E|S1|	||||	|3| |S1|	||||	||||	||||
Adiantum viridimontanum Paris (12)	1	|||| GRank = G1.	||||	|7|T|S2|	||||	||||	||||
ALISMATACEAE							
Echinodorus tenellus (Martius) Buchenau (11) *Echinodorus parvulus* (15) [MA] *Echinodorus tenellus* var. *parvulus* (14) [CT]	1	|||| GRank = G3. GRank is based on synonym, *E. parvulus*.	||||	||||	|H||SX|	||||	|1|E|S1|
Sagittaria rigida Pursh (14)	3*	|3|E|S1|* Disjunct occurrences in Sagadahoc County, Maine.	|||SU|	|+| |S3|	|6+|WL|S2|	|||SU|	|||SU|

NAME	Div	ME	NH	VT	MA	RI	CT
Sagittaria subulata (L.) Buchenau (14)	2	||||	||||	||||	|2|E|S1|	||||	|14|SC|S3|
Sagittaria teres S. Watson (14)	1	|||| GRank = G3.	||||	||||	|54|SC|S3|	|3|E|S1|	||||
AMARANTHACEAE							
Amaranthus pumilus Raf. (14)	4	|||| GRank = G2; Fed. code = LT.	||||	||||	|H| |SH|	|H|SH|SH|	|H|SC *|SH|
Amaranthus tuberculatus (Moq.) Sauer (14)	2	|||SE| Considered adventive in most of New England, but apparently native in Vermont and perhaps New Hampshire.	|||SU|	|6| |S2|	|||SE|	||||	|||SE|
APIACEAE							
Angelica lucida L. (14) *Coelopleurum lucidum* (11) [CT]	IND.	|?| |SU| More field work needed. Not currently tracked in northern states.	|?| |SU|	||||	|9|WL|S2|	|2|T|S1|	|3|E|S1|
Angelica venenosa (Greenway) Fern. (14)	4	||||	||||	||||	|H| |SX|	||||	|||SU|
Hydrocotyle verticillata Thunb. (14)	2	||||	||||	||||	|14|SC|S2|	|H|H|SH|	|H| |SH|
Lilaeopsis chinensis (L.) Kuntze (14)	3*	|5|T|S1|* Disjunct occurrences in Sagadahoc and York Counties, Maine.	|6|T|S2|	||||	|9|WL|S2|	||||	|10|SC|S3|

NAME	Div	ME	NH	VT	MA	RI	CT
Osmorhiza chilensis Hook. & Arn. (14) *Osmorhiza berteroi* (1) [ME]	2	|11+|T|S2|	|H|E|SH|	|H| |SH|	| | |	| | |	| | |
Osmorhiza depauperata Philippi (14) *Osmorhiza obtusa* (11) [VT]	4	| | |	| | |	|H||SH|	| | |	| | |	| | |
Sanicula canadensis L. (14)	2	| | |	|H| |SH|	|9|T|S2|	|8|T|S2|	| | |	| |SU|
Taenidia integerrima (L.) Drude (14)	2	| | |	| | |	|7|T|S2|	|H?| |S?|	|H|H|SH|	|1|SC|S1|
		Reported in 1913 from Massachusetts, but no specimen has been seen.					
Zizia aptera (A. Gray) Fern. (14)	2	| | |	| | |	| | |	| | |	|H|H|SH|	|3|E|S1|
AQUIFOLIACEAE							
Ilex ambigua Torr. var. montana Ahles (13) *Ilex montana* (11) [MA]	2	| | |	| | |	| | |	|3|T|S2|	| | |	| | |
Ilex glabra (L.) A. Gray (14)	3*	|1|E|S1|*	|H|E|SH|	| | |	|+| |S4|	|+| |S3|	|3|T|S1|
		One disjunct occurrence in Knox County, Maine.					
ARISTOLOCHIACEAE							
Aristolochia serpentaria L. (14)	2	| | |	| | |	| | |	| | |	| | |	|6|T|S2|

NAME	Div	ME	NH	VT	MA	RI	CT
ASCLEPIADACEAE							
Asclepias purpurascens L. (14)	2	||||	|H| |SH|	||||	|2|T|S1|	|H| |SH|	|H| |SH|
Asclepias tuberosa L. (14)	3*	|H| |SX|	|H|E|SH|	|H|T|SH|	|+|WL|S3|*	|8|C|S2|	|+| |S4|
		Documented decline of native stands in Massachusetts and possibly other states. May be subject to overcollection in some areas.					
Asclepias variegata L. (14)	2	||||	||||	||||	||||	||||	|1|E|S1|
Asclepias viridiflora Raf. (14)	4	||||	||||	||||	||||	||||	|H|SC *|SH|
ASPLENIACEAE							
Asplenium montanum Willd. (11)	2	||||	||||	|1|T|S1|	|3|E|S1|	|1|E|S1|	|6|T|S2|
Asplenium trichomanes-ramosum L. (12) *Asplenium viride* (14) [VT]	2	|1|E|S1|	||||	|4|T|S1|	||||	||||	||||
ASTERACEAE							
Achillea borealis Bong. (11) *Achillea millefolium* var. *nigrescens* (14)[ME] *Achillea millefolium* var. *borealis* (15) [MA]	IND.	|1?||SH|	|1| |SU|	||||	|||SE?|	||||	||||
		Considered introduced in Massachusetts, but not currently known to be extant. Taxonomic and nomenclatural confusion with certain varieties of *A. millefolium*.					

NAME	Div	ME	NH	VT	MA	RI	CT
Arnica lanceolata Nutt. (14) *Arnica mollis* (11) [VT]	1	|<6| |S2| GRank = G3.	|2|T|S1|	|H||SH|	||||	||||	|||
Artemisia campestris L. ssp. borealis (Pallas) Hall & Clem. (1) *Artemisia campestris* var. *canadensis* (14)	2	|H| |SH|	||||	|3| |S1|	|1|E|S1|	||||	||||
Artemisia campestris L. ssp. caudata (Michx.) Hall & Clem. (14)	3*	|+| |SU| Disjunct occurrences in Grand Isle County, Vermont.	|8|T|S2|	|2| |S1|*	|+| |S4|	|3|C|S1|	|+| |S4|
Aster anticostensis Fern. (14)	4	|H| |SX| GRank = G2Q. Cronquist (Gleason and Cronquist 1991) mentions this taxon, but does not formally include it in his treatment. The northeastern Maine locality is historic.	||||	||||	||||	||||	||||
Aster concolor L. (14)	2	||||	||||	||||	|9|E|S2|	|H|SH|SH|	||||
Aster dumosus L. (14)	3*	|2|E|S1|* Disjunct occurrences in York and Oxford Counties, Maine.	|||SU|	||||	|+| |S4|	|+| |S4|	|+| |S5|
Aster infirmus Michx. (14)	2	||||	||||	||||	|3|E|S1|	|H|SH|SH|	|H| |SH|
Aster praealtus Poiret (14)	IND.	|H?| |SU| Difficult to distinguish from other closely related taxa; more field work needed.	|?| |SU|	||||	|H| |SX|	|H| |SH|	|||SU|

NAME	Div	ME	NH	VT	MA	RI	CT
Aster prenanthoides Muhl. (14)	2	||||	||||	||||	|8|SC|S2|	||||	|H|SC *|SH|
Aster sagittifolius Willd. (14)	2	||||	||||	|1| |S1|	||||	||||	||||
Bidens eatonii Fern. (14)	1	|5|T|S1| GRank = G2G3.	||||	|||	|2|T|S2?|	||||	|3|SC|S1|
Bidens heterodoxa (Fern.) Fern. & St. John (11)	IND.	|||| GRank = G2Q. Cronquist (Gleason and Cronquist 1991) says that the proper taxonomic status is uncertain.	||||	||||	||||	||||	|H| |SH|
Bidens hyperborea Greene (15) *Bidens hyperborea* var. *colpophila* (11) [MA]	2	|11|T|S1S2|	||||	||||	|2|E|S1|	||||	||||
Bidens hyperborea Greene var. svensonii Fassett (1) *Bidens hyperborea* var. *cathancensis* (11)	IND.	|?| |SU|	||||	||||	||||	||||	||||
Cacalia suaveolens L. (14) *Synosma suaveolens* (15) [MA]	4	|||| GRank = G3. GRank is for synonym, *Synosma suaveolens*.	||||	||||	|||SE|	|H|SH|SH|	|H|SC *|SH|
Chrysopsis mariana (L.) Elliott (14)	2	|||	||||	||||	|||!	|2|T|S1|	||||

NAME	Div	ME	NH	VT	MA	RI	CT
Cirsium horridulum Michx. (14)	IND.	||||	|2|E|S1|	||||	|8|WL|S2S3|	|1|T|S1|	|3| |S1|
		More field work needed to clarify status in our region, especially on the islands off Massachusetts.					
Coreopsis rosea Nutt. (14)	1	||||	||||	||||	|+| |S3|	|7|C|S2|	||||
		GRank = G3.					
Erigeron acris L. var. kamtschaticus (DC.) Herder (14) *Trimorpha acris* var. *kamtschatica* (1) [ME]	4	|H||SH|	||||	||||	||||	||||	||||
Eupatorium album L. (14)	2	||||	||||	||||	||||	||||	|2|E|S1|
Eupatorium aromaticum L.	2	||||	||||	||||	|2|E|S1|	|H|SH|SH|	|2|E|S1|
Eupatorium leucolepis (DC.) T. & G. var. novae-angliae Fern. (14)	1	||||	||||	||||	|9|E|S2|	|6|E|S1|	||||
		GRank = G5T1; Fed. code = C2.					
Eupatorium perfoliatum L. var. colpophilum Fern. & Grisc. (14)	IND.	|1?| |S1|	||||	||||	||||	||||	||||
		Taxonomic and distributional status of this variety in New England is unclear.					
Eupatorium rotundifolium L. var. rotundifolium (14)	IND.	||||	||||	||||	||||	||||	|2| |SU|
		Difficult to distinguish from closely related taxa. More field work needed to assess current status.					
Eupatorium sessilifolium L. (14)	3*	||||	|1|E|S1|	|5|E|S1|*	|+| |S4|	|+| |S3|	|+| |S3|
		Vermont occurrences in Rutland County are disjunct.					

NAME	Div	ME	NH	VT	MA	RI	CT
Euthamia galetorum Greene (14) *Euthamia tenuifolia* var. *pycnocephala* (1) [ME]	IND.	|1?||SR|	| |SU|	||||	||||	||||	||||
		GRank = G3Q. Presence in New England is questionable.					
Gnaphalium helleri Britton (14) *Gnaphalium helleri* var. *micradenium* (15) [MA,ME]	IND.	|?||SU|	|?| |SU|	||||	|H||SH|	||||	||||
		Gleason and Cronquist (1991) note that this species is in New England, but we have not seen any specimens.					
Gnaphalium purpureum L. (14) *Gamochaeta purpurea* (1) [MA,ME]	2	|H||SX|	||||	||||	|2?|E|S1|	|H|SH|SH|	|H| |SH|
Gnaphalium supinum L. (14) *Omalotheca supina* (15) [ME]	2	|2|E|S1|	|1|E|S1|	||||	||||	||||	||||
Gnaphalium sylvaticum L. (14) *Omalotheca sylvatica* (15) [ME]	IND.	|4+||SU|	|1| |SU|	|1|E|S1|	||||	||||	||||
		More field work needed to determine current status.					
Hieracium robinsonii (Zahn) Fern. (14)	1	|H| |SH|	|1|E|S1|	||||	||||	||||	||||
		GRank = G1G2; Fed. code = C2.					
Hieracium umbellatum L. (14)	2	||||	|1|E|S1|	||||	||||	||||	||||
Iva frutescens L. var. oraria (Bartlett) Fern. & Griscom (14) *Iva frutescens* ssp. *oraria* (1) [CT,MA,ME,NH,RI]	3*	|3|T|S1|*	|7+|T|S2|	||||	|+||S5|	|+||S3|	|+||S4|
		Disjunct occurrences in Sagadahoc and Cumberland Counties, Maine.					

NAME	Div	ME	NH	VT	MA	RI	CT
Krigia biflora (Walter) S. F. Blake (14)	4	||||	||||	||||	||||	||||	|H| |SH|
Lactuca hirsuta Muhl. (14) *Lactuca hirsuta* var. *sanguinea* (11) [CT,MA,ME,NH]	3*	|H?||SU|	|||SU|	|8|T|S2|*	||WL|SU|	|| |SU|	|H||SH|
		Disjunct occurrences in Chittenden County, Vermont. More field work needed to determine current range in New England.					
Liatris scariosa (L.) Willd. var. novae-angliae Lunell (14) *Liatris borealis* (11) [CT,NH]	1	|4|T|S1|	|6|E|S1|	||||	|33|SC|S3|	|4|T|S1|	|11|SC|S2S3|
		GRank = G5?T3; Fed. code = C2. Former Federal candidate Category 2 status is for synonym *L. borealis*.					
Pityopsis falcata (Pursh) Nutt. (15) *Chrysopsis falcata* (14) [CT,RI]	1	||||	||||	||||	|+| |S3S4|	|8|C|S2|	|3|E|S1|
		GRank = G3G4.					
Polymnia canadensis L. (14)	2	||||	||||	|2|E|S1|	||||	||||	|1|E|S1|
Prenanthes boottii (DC.) A. Gray (14)	1	|3|T|S1|	|4|T|S1|	|2|E|S1|	||||	||||	||||
		GRank = G2; Fed. code = C2.					
Prenanthes × mainensis A. Gray (11)	IND.	|||SU|	||||	||||	||||	||||	||||
		Possibly seen recently, but verification needed. Gleason and Cronquist (1991) note that this is an apparent hybrid of *P. racemosa* with *P. trifoliolata*.					
Prenanthes racemosa Michx. (14)	2	|15| |S2|	||||	||||	||||	||||	||||
		Cronquist (Gleason and Cronquist 1991) suggests that our plants are var. *multiflora*.					
Prenanthes serpentaria Pursh (14)	2	||||	|H| |SH|	||||	|5|E|S1|	|H|SH|SH|	|3| |S1|

NAME	Div	ME	NH	VT	MA	RI	CT
Sclerolepis uniflora (Walter) BSP. (14)	2	||||	|1|E|S1|	||||	|1|E|S1|	|1|E|S1|	||||
		Massachusetts and Rhode Island occurrences cross state boundaries and represent the same population.					
Solidago × calcicola Fern. (13) *Solidago calcicola* (14) [ME,NH]	4	|H||SH|	|H||SH|	||||	||||	||||	||||
		Hybrid between *S. macrophylla* and another species, possibly *S. canadensis*.					
Solidago canadensis L. var. subserrata (DC.) Cronq. (1) *Solidago lepida* var. *molina* (11)	IND.	|?| |SH|	||||	||||	||||	||||	||||
		Solidago canadensis var. *subserrata* is authored by Cronquist but does not appear in Gleason and Cronquist (1991). Fernald (1950) lists this taxon from Maine as *S. lepida* var. *molina*. State rank of "SH" is based on a 20-year cutoff date by the Maine Natural Areas Program.					
Solidago cutleri Fern. (14) *Solidago multiradiata* var. *arctica* (1) [ME]	2	|6||S1S2|	|9|T|S3|	|1| |S1|	||||	||||	||||
Solidago ptarmicoides (Nees) B. Boivin (14) *Aster ptarmicoides* (11) [NH,VT]	2	||||	|2|E|S1|	|11||S2S3|	|4|T|S1S2|	||||	|1|E|S1|
Solidago rigida L. (11)	2	||||	||||	||||	|H| |SX|	|H| |SH|	|4|E|S1|

NAME	Div	ME	NH	VT	MA	RI	CT
Solidago simplex HBK. ssp. randii (Porter) Ringius var. monticola (Porter) Ringius (14) *Solidago simplex* var. *randii* (1) [ME] *Solidago glutinosa* ssp. *randii* (31) [MA,NH]	3*	|+||S4|	|+||S4|*	||||	|4|E|S1|*	||||	||||
		Disjunct at sites in southern Berkshire County in Massachusetts and in Cheshire County in New Hampshire. According to Gleason and Cronquist (1991), there are three varieties of the subspecies. The current distribution and status of New England taxa are unclear.					
Tanacetum bipinnatum (L.) Schultz-Bip. ssp. huronense (Nutt.) Breitung (1) *Tanacetum huronense* (14)	2(a)	|30| |S2|	||||	||||	||||	||||	|||
		Restricted to St. John River. Small population sizes and ephemeral nature of the habitat are cause for concern.					
Taraxacum ceratophorum (Ledeb.) DC. (14) *Taraxacum latilobum* (11) [ME]	IND.	|H?||SU|	||||	||||	||||	||||	||||
		Two old specimens of *T. latilobum* are unverified.					
BERBERIDACEAE Podophyllum peltatum L. (14)	2	|||SE|	|1?||SU|	|2||S1|	|||SE|	|||SE|	|||SU|
		This species has been introduced into all New England states. Although probably native in some states (Connecticut, New Hampshire, and Vermont), determining if an occurrence is native or introduced is often difficult. It is considered native at some locations in New York state.					

NAME	Div	ME	NH	VT	MA	RI	CT
BETULACEAE							
Betula glandulosa Michx. (14) *Betula nana* (1) [M]	2	|1|E|S1|	|11|T|S1|	||||	||||	||||	||||
Betula minor (Tuckerm.) Fern. (13) *Betula borealis* (11) [VT] *Betula* × *minor* (1) [ME]	1	|1|E|S1|	|9| |S2|	|H||SH|`	||||	||||	||||
GRank = G3G4Q. Gleason and Cronquist (1991) note this as a hybrid of *B. glandulosa* var. *glandulosa* with a dwarf, alpine form of *B. papyrifera*, perhaps locally alloploid.							
Betula nigra L. (14)	2	||||	|6|T|S2|	||||	|3?|WL|S1|	||||	|||SU|
Native and introduced populations occur in New England; it is often difficult to determine which occurrences are native and which are introduced.							
Betula pumila L. (14)	3*	|+| |S3|	|1|E|S1|*	|1|E|S1|	|4|T|S2|	||||	|8|SC|S2|
Ecological anomaly at a New Hampshire acidic fen.							
BORAGINACEAE							
Cynoglossum virginianum L. var. boreale (Fern.) Cooperrider (14) *Cynoglossum boreale* (11) [MA,NH,VT] *Cynoglossum virginianum* (15) [CT]	1	|?| |SH|	|1|E|S1|	|2|T|S1|	|H||SX|	||||	|H|SC *|SH|
GRank = G5T3? The Connecticut endangered species list includes var. *boreale* and var. *virginianum* under *C. virginianum.*							
Cynoglossum virginianum L. var. virginianum (14) *Cynoglossum virginianum* (15) [CT]	4	||||	||||	||||	||||	||||	|H|SC *|SH|
The Connecticut endangered species list includes var. *virginianum* and var. *boreale* under *C. virginianum*.							

NAME	Div	ME	NH	VT	MA	RI	CT
Hackelia deflexa (Wahlenb.) Opiz var. americana (A. Gray) Fern. & I.M. Johnston (14) *Hackelia americana* (40) [VT]	2	|1|E|S1|	|1|E|S1|	|16|T|S2|	||||	||||	||||
Mertensia maritima (L.) S. F. Gray (14)	3*	|+| |S3S4|	||||	||||	|6|E|S1|*	||||	||||
		Disjunct in Barnstable and Nantucket Counties, Massachusetts.					
Onosmodium virginianum (L.) A. DC. (14)	2	||||	||||	||||	|H| |SX|	|H|SH|SH|	|1|E|S1|
BRASSICACEAE							
Arabis drummondii A. Gray (14)	3*	|+| |S4|	|+?| |S3?|	|2|E|S1|*	|2|WL|S1|	|H|SH|SH|	|||SU|
		Vermont occurrences in Rutland and Addison Counties are disjunct.					
Arabis laevigata (Muhl.) Poiret (14)	3*	|2|E|S1|*	|H| |S1|	|+| |S4|	|10|T|S2|	|||SU|	|+| |S3|
		Disjunct in Franklin, Aroostook, and Piscataquis Counties in Maine.					
Arabis missouriensis Greene (14)	IND.	|4|T|S1|	|3|T|S1S2|	|2| |S1|	|9|T|S2|	|||SU|	|||SU|
		Taxonomic question and difficulty in distinguishing this taxon from *A. laevigata* into which one author (see Mulligan 1995) has recently placed this taxon.					
Barbarea orthoceras Ledeb. (14)	2	|H| |SH|	|1|E|S1|	||||	||||	||||	||||
Braya humilis B. L. Robinson (14)	2	||||	||||	|2|T|S1|	||||	||||	||||

NAME	Div	ME	NH	VT	MA	RI	CT
Cardamine bellidifolia L. (14)	2	|1|E|S1|	|3|E|S1|	||||	||||	||||	||||
Cardamine concatenata (Michx.) O. Schwarz (14) *Dentaria laciniata* (11) [CT,MA,NH,VT]	3*	|1|E|S1|* Aroostook County, Maine, occurrence is disjunct.	|2|E|S1|	|+||S3|	|+||S3|	||||	|+||S3|
Cardamine douglassii Britt. (11)	2	||||	||||	||||	|1|E|S1|	||||	|7|SC|S2|
Cardamine × incisa K. Schum. (*pro sp.*) (15) *Dentaria* × *incisifolia* (11) [MA]	IND.	|||| Fernald (1950) suggests that this is a hybrid of *Dentaria laciniata* (*C. concatenata*) and *Dentaria maxima* (*C.* × *maxima*). Gleason and Cronquist (1991) mention this taxon under *C. angustata* (as *D. incisifolia*), but do not formally include this taxon in their treatment.	||||	||||	|||SU|	||||	|2| |SU|
Cardamine longii Fern. (14)	1	|9|T|S2| GRank = G3Q; Fed. code = 3C.	|H|T|SH|	||||	|2|E|S1|	|1|E|S1|	|H| |SH|
Cardamine × maxima (Nutt.) A. Wood (14) *Cardamine maxima* (15) [ME] *Dentaria maxima* (14) [CT,MA,NH]	IND.	|H||SH| Taxonomic status unclear. Gleason and Cronquist (1991) suggest this as possibly a sterile hybrid between *C. diphylla* and *C. concatenata*.	|H||SH|	||||	|2|WL|S1|	||||	|H||SH|
Cardamine pratensis L. var. palustris Wimmer & Graebner (14)	2	||||	|1|E|S1|	|3| |S1|	|3|T|S1|	||||	| |SU|

NAME	Div	ME	NH	VT	MA	RI	CT
Descurainia pinnata (Walter) Britton var. brachycarpa (Richardson) Fern. (14)	2	||||	|H| |SX|	|2| |S1|	|| |SE|	||||	||||
Descurainia richardsonii (Sweet) O. E. Schulz (14) *Descurainia incana* (15) [ME]	4	|H||SH|	||||	||||	||||	||||	||||
Draba arabisans Michx. (14)	2	|3|T|S1|	||||	|10| |S2S3|	||||	||||	||||
		Tracking of this species was only recently begun in Vermont. It may be more abundant than is now known (which is reflected in the S2S3 ranking).					
Draba cana Rydb. (14) *Draba lanceolata* (11) [ME,NH,VT]	2	|1|E|S1|	|1|E|S1|	|3|T|S1|	||||	||||	||||
Draba glabella Pursh (14)	2	||||	||||	|5| |S1|	||||	||||	||||
Draba reptans (Lam.) Fern. (14)	2	||||	||||	||||	|H| |SX|	|H|SH|SH|	|4|SC|S2|
Neobeckia aquatica (Eaton) Greene (18) *Armoracia lacustris* (14) [MA,ME,VT]	2	|H?||SH?|	||||	|4|T|S1|	|H||SH?|	||||	||||
		Type locality for this species is in western Massachusetts, but no specimens have been seen from Massachusetts or Maine.					
Subularia aquatica L. (14)	2	|9| |S2|	|| |SU|	|H| |SH|	||||	||||	||||

NAME	Div	ME	NH	VT	MA	RI	CT
CAESALPINIACEAE							
Cercis canadensis L. (14)	4	||||	||||	||||	||||	||||	|H|SC *|SH|
		Literature reports indicate that this was native at one site in Connecticut, but it is no longer extant there. Only naturalized occurrences remain.					
Senna hebecarpa (Fern.) Irwin & Barneby (14) *Cassia hebecarpa* (11) [CT,NH,VT]	2	||||	|H|E|SH|	|H|T|SH|	|2|E|S1|	|1|T|S1|	|2|SC|S1|
CALLITRICHACEAE							
Callitriche hermaphroditica L. (14)	4	||||	||||	|H| |SH|	||||	||||	||||
Callitriche terrestris Raf. (14)	4	||||	||||	||||	|H| |SH|	||||	|H| |SH|
CAMPANULACEAE							
Lobelia spicata Lam. var. hirtella A. Gray (14)	IND.	|||SU|	|H| |SH|	||||	||||	||||	||||
		Current status and distribution of this variety is unclear.					
CAPRIFOLIACEAE							
Lonicera dioica L. (14)	3*	|1|E|S1|*	||SU|	|+| |S4|	|+| |S4|	|3|C|S1|	|+| |S3|
		Cumberland County, Maine, occurrence is disjunct.					
Lonicera hirsuta Eaton (14)	2	||||	||||	|12| |S2|	|3|E|S1|	||||	||||

NAME	Div	ME	NH	VT	MA	RI	CT
Lonicera sempervirens L. (14)	IND.	|2|E|S1|	| |SU|	| |SE|	| |SE|	| |SE|	| |SU|
		Difficult to determine which populations are native. Introduced occurrences in Vermont are no longer extant.					
Symphoricarpos albus (L.) S.F. Blake var. albus (14)	3*	||||	||||	|+| |S3|	|1|E|S1|*	||||	||||
		Occurrence in Franklin County, Massachusetts, is disjunct from western Vermont occurrences.					
Triosteum angustifolium L. (14)	4	||||	||||	||||	||||	||||	|H|SC *|SH|
		Gleason and Cronquist (1991) distinguish two varieties, but both are historic in New England.					
Triosteum aurantiacum E. Bickn. (14)	3*	|2|T|S1|*	|2|E|S1|	|+| |S3|	|+| |S4|	|4|T|S1|	|+| |S3|
		Aroostook County, Maine, occurrence is disjunct.					
Triosteum perfoliatum L. (14)	2	||||	||||	||||	|4-5|E|S1	|4|C|S1|	| |SU|
Viburnum nudum L. var. nudum (14) *Viburnum nudum* (11) [CT,RI]	2	||||	||||	||||	||||	|1|T|S1|	|H|SC *|SH|
Viburnum prunifolium L. (14)	2	||||	||||	||||	||||	||||	|8|SC|S2|
Viburnum rafinesquianum Schultes (14)	3*	||||	|5|E|SE|*	|+| |S3|	|4|T|S2|	||||	|+| |S3|
		Southern Rockingham County, New Hampshire, occurrences are disjunct.					

NAME	Div	ME	NH	VT	MA	RI	CT
CARYOPHYLLACEAE							
Arenaria caroliniana Walter (14) *Minuartia caroliniana* (15)	4	||||	||||	||||	||||	|H|SH|SH|	||||
Cerastium nutans Raf. (14)	2	||||	||||	|?| |S2|	|1|E|S1|	||||	|||SU|
Minuartia glabra (Michx.) Mattf. (15) *Arenaria glabra* (8) [CT,RI] *Arenaria groenlandica* var. *glabra* (14)	2(a)	|8| |S1S2|	|4|T|S2|	||||	||||	|2|E|S1|	|7|T|S2|
		Small population sizes of some occurrences are cause for concern.					
Minuartia groenlandica (Retz.) Ostenf. (15) *Arenaria groenlandica* var. *groenlandica* (14)	3*	|24| |S3|	|+| |S4|	|2| |S1|*	||||	||||	||||
		High peak occurrences in Chittenden, Lamoille, and Washington Counties in Vermont are disjunct.					
Minuartia marcescens (Fern.) House (15) *Arenaria marcescens* (11)	1	||||	||||	|1|T|S1|	||||	||||	||||
		GRank = G2; Fed. code = C2. Not included in Gleason and Cronquist (1991).					
Minuartia rubella (Wahlenb.) Heirn (15) *Arenaria rubella* (14)	2	|1|E|S1|	||||	|1|T|S1|	||||	||||	||||
Moehringia macrophylla (Hook.) Fenzl (15) *Arenaria macrophylla* (14) [CT]	2	||||	||||	|9| |S2|	|4|T|S1S2|	||||	2|E|S1|

NAME	Div	ME	NH	VT	MA	RI	CT
Paronychia argyrocoma (Michx.) Nutt. (14) *Paronychia argyrocoma* var. *albimontana* (11) [NH]	2(a)	|8| |S1S2|	|16|T|S3|	||||	|1|E|S1|	||||	||||
		Small population sizes of some occurrences are cause for concern.					
Paronychia canadensis (L.) A. Wood (14)	3*	||||	|7|T|S1|	|3| |S1|*	|+| |S4|	|| |SU|	|+| |S4
		One occurrence on Lake Champlain in Franklin County, Vermont, is disjunct.					
Paronychia fastigiata (Raf.) Fern. (14)	IND.	||||	||||	||||	|||SE?|	||||	|||SU|
		Massachusetts occurrences may be adventive.					
Sagina decumbens (Ell.) T. & G. (14)	IND.	||||	||||	|H| |SH|	|1|WL|SU|	||||	|||SU|
		More study needed to clarify status. Is the Massachusetts occurrence truly native?					
Sagina nodosa (L.) Fenzl ssp. borealis Crow (15) *Sagina nodosa* var. *borealis* (14)	2	|10| |S2?|	||||	||||	|||SU|	||||	||||
Sagina nodosa (L.) Fenzl ssp. nodosa (14)	IND.	|||SE|	|H| |SH|	||||	|3|T|S2|	||||	||||
		This taxon is considered introduced by most botanists, but there are some questions about the Massachusetts occurrences. Gleason and Cronquist (1991) consider this to be a glandular-hairy variety introduced from Europe.					
Silene acaulis (L.) Jacq. (13) *Silene acaulis* var. *exscapa* (11) [ME,NH]	2	|H||SH|	|2|T|S1|	||||	||||	||||	||||

NAME	Div	ME	NH	VT	MA	RI	CT
Silene stellata (L.) Aiton f. (14)	2	||||	||||	|H| |SH|	||||	|H|SH|SH|	|3| |S1|
CERATOPHYLLACEAE							
Ceratophyllum echinatum A. Gray (14)	3*	2| |SH|* Occurrences in Penobscot and Waldo Counties, Maine, are disjunct, but were last recorded in 1971 and 1975. State rank of "SH" for Maine is based on a 20-year cutoff date used by the Maine Natural Areas Program.	|2-3| |SU|	|6| |S2|	|+| |S3?|	|| |SU|	|+| |S3|
CHENOPODIACEAE							
Chenopodium foggii H. A. Wahl (15) *Chenopodium pratericola* (14) [VT]	IND.	|||| GRank = G3?Q. Gleason and Cronquist (1991) place this taxon under *C. pratericola* and consider it introduced from the west. Massachusetts considers it native and historic. Vermont does not separate *C. foggii* from *C. pratericola* (which is historic there). More field work needed.	|?| |SU|	|H||SH|	|H|WL|SH|	||||	||||
Chenopodium leptophyllum Nutt. (14)	IND.	|||SU| More field study needed to assess status. Most authors consider the eastern U.S. populations of this taxon to be introductions. Some authors have included the taxon under *C. pratericola.*	||||	||||	||||	|2|C|S1|	||||
Chenopodium rubrum L. (14)	3*	|4|T|S1|* Lincoln and Washington Counties, Maine, occurrences are disjunct.	|1|T|S2|	||||	|+| |S4|	|| |SU|	|| |SU|

NAME	Div	ME	NH	VT	MA	RI	CT
Chenopodium standleyanum Aellen (14) *Chenopodium berlanderi* var. *boscianum* (15) [ME] *Chenopodium boscianum* (11) [NH]	IND.	|1?||SU|	|1|E|S2|	||||	||WL|SE?|	||||	|||SU|
		Difficult to distinguish. More field study needed. *C. standleyanum* is considered native and *C. boscianum* may be introduced.					
Suaeda americana (Pers.) Fern. (14) *Suaeda calceoliformis* (1) [ME]	IND.	|H| |SH|	||||	||||	|12|SC|S3|	||||	|||SU|
Suaeda maritima (L.) Dumort. (11) *Suaeda maritima* ssp. *richii* (1) [MA,ME]	IND.	|1|E|S1|	||||	||||	|7|WL|S3?|	|||SU|	|||SU|
		GRank = G5T3?.					
CISTACEAE							
Helianthemum dumosum (E. Bickn.) Fern. (14)	1	||||	||||	||||	|92|SC|S3|	|5|E|S1|	|H|SC *|SH|
		GRank = G3; Fed. code = C2. Massachusetts has the largest number of occurrences globally, but small population sizes and diminishing habitat of many occurrences are cause for concern.					
Hudsonia tomentosa Nutt. (14)	3*	|+| |S3S4|	|14|T|S1|	|4|E|S1|*	|+| |S4|	|10| |S2|	|5|T|S2|
		Occurrences in Chittenden and Grand Isle Counties, Vermont, as well as New York occurrences on Lake Champlain, are disjunct from the rest of this species' range in New England.					

NAME	Div	ME	NH	VT	MA	RI	CT
Lechea minor L. (14)	IND.	||||	||||	|H| |SH|	|10|WL|S2?|	|||SU|	|||SU|
		Current status in most New England states is unknown.					
CLUSIACEAE							
Hypericum adpressum Barton (14)	1	||||	||||	||||	|8|T|S2|	|5|T|S1|	|H|SC *|SH|
		GRank = G2G3; Fed. code = C2.					
Hypericum stragulum P. Adams & Robson (14) *Hypericum hypericoides* ssp. *multicaule* (15) [MA]	2	||||	||||	||||	|8|E|S2|	||||	||||
CONVOLVULACEAE							
Calystegia spithamaea (L.) Pursh (14) *Convolvulus spithamaeus* (11) [NH]	2	|3|T|S1|	|2|T|S2|	|8|T|S2|	|2|E|S1|	||||	|H| |SH|
CORNACEAE							
Cornus florida L. (14)	3*	|3|E|S1|	|+|SC|S3|	|5|T|S1|*	|+| |S4|	|+| |S4|	|+| |S4|
		Strongly declining in Vermont due to an anthracnose fungus (*Discula* sp.).					
CRASSULACEAE							
Sedum rosea (L.) Scop. (14)	3*	|+| |S3|	||||	|2|T|S1|*	||||	||||	||||
		Occurrences in Bennington and Windsor Counties, Vermont, are disjunct.					

NAME	Div	ME	NH	VT	MA	RI	CT
CUPRESSACEAE							
Juniperus horizontalis Moench (14)	3*	|+| |S3S4|	|2|E|S1|*	|2|T|S1|*	| |SE|	|||	|||
		Species disjunct in Grafton County, New Hampshire, and in Bennington County, Vermont.					
CUSCUTACEAE							
Cuscuta coryli Engelm. (14)	2	|||	|||	|||	|6|WL|S2	|H| |SH|	|H|SC *|SH|
		Difficult to distinguish. May be overlooked.					
Cuscuta pentagona Engelm. (14)	IND.	|||	|H|E|SH|	|||	|+?| |S3|	|H| |SH|	|H| |SH|
		Difficult to distinguish. May be overlooked.					
CYPERACEAE							
Bolboschoenus maritimus (L.) Palla (1) *Scirpus maritimus* (14) [MA,NH,RI,VT] *Scirpus paludosus* var. *atlanticus* (11) [CT]	3*	|+| |S4?|	|+||S3S4|	|1||S1|*	|+||S4|	|4|C|S1|	|9|SC|S2|
		Disjunct in Addison County, Vermont.					
Bolboschoenus novae-angliae (Britt.) S.G. Smith (1) *Scirpus cylindricus* (14) [CT,MA]	2	|H?| |SU|	||||	||||	|6|WL|S2|	||||	|8|SC|S2S3|
Carex adusta F. Boott (14)	2	|4|E|S1|	|||SU|	||||	||||	||||	||||

NAME	Div	ME	NH	VT	MA	RI	CT
Carex albicans Willd. var. emmonsii (Dewey) Rettig (14) *Carex emmonsii* (11) [CT,NH,RI,VT]	3*	|+| |S4|	|1||S1|	|1||S1|*	|+| |S4|	|3||S1|	|+||S3|
		Disjunct in Chittenden County, Vermont.					
Carex alopecoidea Tuckerm. (14)	2	|1|E|S1|	| | | |	|4| |S1|	|6|T|S2|	| | | |	|H|SC *|SH|
Carex arcta F. Boott (14)	3*	|+| |S4?|	| | |SU|	|2|E|S1|*	| | | |	| | | |	| | | |
		Disjunct occurrences in Grand Isle and Franklin Counties, Vermont.					
Carex atherodes Sprengel (14)	4	|H| |SH|	| | | |	| | | |	| | | |	| | | |	| | | |
Carex atratiformis Britt. (14)	2	|10-15| |S2|	|H| |SH|	|1|T|S1|	| | | |	| | | |	| | | |
Carex backii F. Boott (14)	3*	|2| |S1|*	| | |SU|	|+| |S3|	| | | |	| | | |	|1| |S1|
		Disjunct occurrences in Penobscot County, Maine.					
Carex baileyi Britt. (14)	3*	|1| |S1?|*	|3-5?|T|S1S2|+| |SU|		|5|E|S1|	| | | |	|H|SC *|SH|
		Disjunct occurrence in Oxford County, Maine.					
Carex barrattii Schwein. & Torr. (14)	2	| | | |	| | | |	| | | |	| | | |	| | | |	|2|SC|S1
Carex bicknellii Britt. (14)	IND.	|H| |SH|	| | | |	|H| |SH|	|+?| |S3?|	| | |SU|	| | |SU|
		More field study needed.					
Carex bigelowii Torr. (14)	3*	|13| |S2|	|+| |S3|	|4| |S1|*	| | | |	| | | |	| | | |
		Occurrences in Chittenden, Addison, Lamoille, and Washington Counties, Vermont, are disjunct.					

NAME	Div	ME	NH	VT	MA	RI	CT
Carex bushii Mackenzie (14)	2	|H| |SX|	| | | |	|H| |SH|	|3|E|S1|	|H| |SH|	|2| |S1|
Carex buxbaumii Wahlenb. (14)	3*	|+| |S4|	|H|E|SH|	|1|E|S1|*	|11|WL|S2|	|H|SH|SH|	|2|E|S1|
		Disjunct occurrence near Lake Champlain in Addison County, Vermont.					
Carex capillaris L. (14) *Carex capillaris* ssp. *capillaris* (27)	2	|6| |S1|	|1|T|S1|	|1|T|S1|	| | | |	| | | |	| | | |
Carex capitata L. (14) *Carex capitata* ssp. *arctogena* (15) [NH]	2	| | | |	|3||S1|	| | | |	| | | |	| | | |	| | | |
Carex chordorrhiza L. f. (14)	3*	|+| |S4?|	| | | |	|2|E|S1|*	|1|E|S1|*	| | | |	| | | |
		Disjunct in Bennington County, Vermont, and in Berkshire County, Massachusetts.					
Carex collinsii Nutt. (14)	2	| | | |	| | | |	| | | |	| | | |	|1|E|S1|	|H|SC *|SH|
		Last seen in 1979. This species has not been re-located in recent searches.					
Carex crawei Dewey (14)	2	|1| |S1|	| | | |	| | | |	| | | |	| | | |	|5|E|S1S2|
Carex davisii Schwein. & Torr. (14)	2	| | | |	| | | |	|1| |S1|	|1|E|S1|	| | | |	|2|E|S1|
Carex eburnea F. Boott (14)	3*	|2|T|S1|*	|1|E|S1|	|+| |S4|	|+| |S3|	| | | |	|+| |S3|
		Disjunct in Oxford County, Maine.					

NAME	Div	ME	NH	VT	MA	RI	CT
Carex garberi Fern. (15) *Carex garberi* var. *bifaria* (11) [NH]	1	|14?| |S2|	|6|E|S1|	|4|T|S1|	||||	||||	||||
		GRank = G4T3Q; Fed. code = C2. GRank is for synonym *C. garberi* var. *bifaria*.					
Carex glaucodea Tuckerm. (13) *Carex flaccosperma* var. *glaucodea* (14)	2	||||	|H|E|SH|	||||	|4|E|S1|	||||	|1| |S1|
Carex gracilescens Steudel (14)	2	||||	|H| |SH|	|H| |SH|	|1|E|S1|	||||	|5| |S2|
Carex gynocrates Drej. (1) *Carex dioica* var. *gynocrates* (14)	IND.	|10+| |S2S3|	||||	||||	||||	||||	||||
		Possibly overlooked.					
Carex livida (Wahlenb.) Willd. (14) *Carex livida* var. *radicaulis* (1) [MA,ME]	2	|5|T|S1S2|	||||	|1|T|S1|	|1|E|S1|	||||	||||
Carex lupuliformis Sartwell (14)	1	||||	||||	|6| |S2|	||||	||||	|2|SC|S1|
		GRank = G3?.					
Carex mitchelliana M. A. Curtis (14)	1	||||	||||	||||	|5|WL|S2|	|||SU|	||||
		GRank = G3G4.					
Carex muhlenbergii Schk. (14)	3*	|H| |SH|	|||SU|	|6|T|S2|*	|+| |S4S5|	|||SU|	|+| |S3|
		Disjunct occurrences in Chittenden County, Vermont. Reportedly extant in Maine in 1996.					

NAME	Div	ME	NH	VT	MA	RI	CT
Carex nigromarginata Schwein. (14)	4	||||	||||	||||	||||	||||	|H|SC *|SH|
Carex norvegica Retz. (14)	2	|1|E|S1|	||||	||||	||||	||||	||||
		Taxonomy of this and closely related species is currently being studied.					
Carex oligocarpa Schk. (14)	2	||||	||||	|4|E|S1|	|H| |SH|	||||	|1|E|S1|
Carex oronensis Fern. (14)	1	|51|E|S2|	||||	||||	||||	||||	||||
		GRank = G2; Fed. code = C2. All records are from the Penobscot River watershed.					
Carex polymorpha Muhl. (14)	1	|5|T|S1|	|1|T|S1|	||||	|2|E|S1|	|1|E|S1|	|3|E|S1
		GRank = G2G3; Fed. code = C2.					
Carex prairea Dewey (14)	3*	|5|T|S1|*	||||	|+| |S4|	|~8|WL|S2|	||||	|7|T|S2|
		Maine occurrences are disjunct in Aroostook County.					
Carex praticola Rydb. (14)	4	|H| |SX|	||||	||||	||||	||||	||||
Carex rariflora (Wahlenb.) J.E. Smith (14)	4	|H| |SH|	||||	||||	||||	||||	||||
Carex recta Boott (15)	IND.	|1|E|S1|	||||	||||	|1|E|S1|	||||	||||
		This taxon is listed in Gleason and Cronquist (1991) as a synonym under *C. salina*, but FNA may treat this as a separate species. Thought to be a stabilized hybrid between *C. aquatilis* and *C. pallacea*. More study needed.					

NAME	Div	ME	NH	VT	MA	RI	CT
Carex richardsonii R. Br. (14)	2	||||	||||	|2|E|S1|	||||	||||	||||
Carex saxatilis L. (14)	2	|2|E|S1|	||||	||||	||||	||||	||||
Carex schweinitzii Dewey (14)	1	||||	||||	|14| |S2|	|3|E|S1|	|H|SH|SH|	|3|T|S1|
		GRank = G3; Fed. code = C2.					
Carex scirpoidea Michx. (14)	2	|2|T|S1|	6|T|S1|	|11| |S2|	||||	||||	||||
Carex siccata Dewey (14) *Carex foenea* (11) [CT,MA,NH,VT]	3*	|H?| |SU|	|||SU|	|2|E|S1|*	|+||S3?|	|||SU|	|H||SH|
		One occurrence in Chittenden County, Vermont, is disjunct. Note: the taxon formerly known as *C. foenea* is now *C. siccata*, and what was formerly known as *C. aenea* is now known as *C. foenea*.					
Carex sparganioides Muhl. (14)	3*	|1|E|S1|*	|1|E|S1|	|+| |S4|	|+| |S4|	|1|C|S1|	|+| |S3|
		Disjunct in Oxford County, Maine, but varieties in New England need examination.					
Carex sterilis Willd. (14)	2	|3|T|S1|	||||	||||	|7|T|S2|	|H| |SH|	|9|SC|S2|
Carex striata Michx. var. brevis L. Bailey (14)	2	||||	|1| |S1|	||||	|5|E|S1|	|1|E|S1|	||||
Carex striatula Michx. (14)	2	||||	||||	||||	||||	||||	|2| |S1|
Carex tenuiflora Wahlenb. (14)	2	|8| |S2|	||||	|4| |S1|	||||	||||	||||

NAME	Div	ME	NH	VT	MA	RI	CT
Carex tetanica Schk. (14)	2(a)	||||	||||	||||	|14|SC|S3|	||||	|7|SC|S2S3|
		Small population sizes of some occurrences are cause for concern.					
Carex trichocarpa Muhl. (14)	2	||||	|1|E|S1|	|7| |S2|	|8|T|S2|	||||	|1| |S1|
Carex vaginata Tausch (14)	2	|3|T|S1|	||||	|3|E|S1|	||||	||||	||||
Carex wiegandii Mackenzie (14)	1	|7| |S2| GRank = G3.	|4|T|S1S2|	|H| |SH|	|H| |SH|	||||	||||
Carex willdenowii Schk. (14)	4	||||	||||	|H| |SH|	|H| |SH|	||||	|H|SC *|SH|
Carex woodii Dewey (14)	4	||||	|H| |SX|	||||	||||	|||	|H|SC *|SH|
Cyperus engelmannii Steud. (14)	IND.	||||	||||	|H| |SH|	|6|SC|S3?|	||||	|||SU|
		Taxonomic confusion. A future FNA treatment probably will combine *C. engelmannii* and *C. odoratus*, but Massachusetts separates the two species. These taxa are separated here pending further review.					
Cyperus houghtonii Torr. (14)	2	|H| |SH|	|2|T|S1|	|14|T|S2|	|3|E|S1|	||||	||||
		Some populations small and threatened.					
Cyperus odoratus L. (14)	IND.	||||	||||	|H| |SH|	|4|WL|S3?|	|H| |SH|	|||SU|
		Taxonomic confusion. A future FNA treatment probably will combine *C. engelmannii* and *C. odoratus*, but Massachusetts separates the two species. These taxa are separated here pending further review.					

NAME	Div	ME	NH	VT	MA	RI	CT
Eleocharis equisetoides (Elliott) Torr. (14)	2	||||	||||	||||	|H| |SX|	|8|C|S2|	|1|E|S1|
Eleocharis fallax Weatherby (14)	2	||||	||||	||||	|H| |SH|	|||SU|	|1| |SU|
Eleocharis microcarpa Torr. var. filiculmis Torr. (11) *Eleocharis microcarpa* (14) [RI]	2	||||	||||	||||	|1|E|S1|	|1|E|S1|	|H|SC *|SH|
Eleocharis nitida Fernald (11)	IND.	|||SR|	|H| |SH|	|H| |SH|	||||	||||	||||
GRank = G3G4. Possible occurrence in Maine needs verification.							
Eleocharis ovata (Roth) Roemer & Schultes (14) *Eleocharis obtusa* var. *ovata* (14) [CT,MA,ME,VT] *Eleocharis ovata* var. *heurseri* (13) [ME,NH]	IND.	|+|||	|||SU|	|5||S1|	|3|E|S1|	|||SU|	|+||SU|
Taxonomic confusion surrounds this taxon in New England; it is included within the common and widespread *E. obtusa* by some authors.							
Eleocharis pauciflora (Lightf.) Link var. fernaldii Svens. (11) *Eleocharis pauciflora* (14) [VT] *Eleocharis quinqueflora* (15) [ME]	2	|2|E|S1|	|2|E|S1|	|3|T|S1|	|1|E|S1|	||||	||||
Eleocharis quadrangulata (Michx.) Roemer & Schultes (14)	2	||||	||||	||||	|H| |SX|	||||	|2|E|S1|

NAME	Div	ME	NH	VT	MA	RI	CT
Eleocharis rostellata (Torr.) Torr. (14)	IND.	|H| |SH|	||||	||||	|10+|WL|S3|	|2|C|S1|	|||SU|
		More field study needed to determine status in New England.					
Eleocharis tricostata Torr. (14)	2	||||	||||	||||	|2|E|S1|	|H|SH|SH|	||||
Eleocharis tuberculosa (Michx.) Roemer & Schultes (14)	3*	|1|E|S1|*	|H|E|SH|	||||	|+| |S4|	|3+| |S2|	|+| |S3|
		Since New Hampshire occurrences are now historic, the Oxford County, Maine, occurrence is disjunct.					
Fuirena pumila (Torr.) Sprengel (14)	3*	||||	||||	||||	|34|WL|S3|*	|2|SE|S1|	|H| |SH|
		The Hampden County, Massachusetts, occurrence is disjunct.					
Rhynchospora capillacea Torr. (14)	2	|2|E|S1|	|1|E|S1|	|2|T|S1|	|2|E|S1|	||||	|2|E|S1|
Rhynchospora inundata (Oakes) Fern. (14)	2	||||	||||	||||	|6|T|S2|	|4|E|S1|	||||
Rhynchospora nitens (Vahl) A. Gray (14) *Psilocarya nitens* (11)	2	||||	||||	||||	|11|T|S2|	||||	||||
Rhynchospora torreyana A. Gray (14)	2	||||	||||	||||	|10|E|S2|	|1|E|S1|	||||
Schoenoplectus etuberculatus (Steud.) Sojak (13) *Scirpus etuberculatus* (14) [RI]	1	||||	||||	||||	||||	|1|E|S1|	||||

NAME	Div	ME	NH	VT	MA	RI	CT
Schoenoplectus hallii (A.Gray) S.G. Smith (30) *Scirpus hallii* (11) [MA]	4	||||	||||	||||	|H||SX|	||||	||||
		GRank = G2; Fed. code = C2. GRanks and Federal codes are for synonym, *Scirpus hallii*. Future FNA editions will probably use the name *Schoenoplectus hallii*.					
Schoenoplectus heterochaetus (Chase) Sojak (28) *Scirpus heterochaetus* (14) [MA,VT]	IND.	||||	||||	|?||S2S3|	||WL|SU|	||||	||||
		May be more common in Vermont than current records indicate, hence the S2S3 ranking. Populations are difficult to delineate.					
Schoenoplectus × steinmetzii (Fern.) S.G. Smith & A.E. Schuyler (1) *Scirpus steinmetzii* (11)	IND.	|1||S1|	||||	||||	||||	||||	||||
		GRank = G1Q. Sterile hybrid of *S. heterochaetus* × *S. tabernaemontani*. One isolated population persisting via vegetative reproduction.					
Scirpus ancistrochaetus Schuyler (13)	1	||||	|5-7| |S1|	|9|E|S2|	|1|E|S1|	||||	||||
		GRank = G3; Fed. code = LE. This species does not appear in any manuals. See A. E. Schuyler's 1962 paper (*Rhodora* 64: 43-49) for a description.					
Scirpus longii Fern. (14)	1	|9|E|S1|	|1| |S1|	||||	|4|E|S1|	|1|E|S1|	|H|SC *|SH|
		GRank = G2; Fed. code = C2.					
Scirpus pendulus Muhl. (14)	3*	|3|E|S1|*	|3|T|S2|	|+| |S3|	|26|WL|S3|	||||	|+| |S3|
		Disjunct in Penobscot County, Maine.					
Scirpus polyphyllus Vahl (14)	2	||||	|H|E|SH|	|2|E|S1|	|5|WL|S1|	||||	|H| |SH|

NAME	Div	ME	NH	VT	MA	RI	CT
Scleria pauciflora Muhl. (14) *Scleria pauciflora* var. *caroliniana* (11) [CT,MA]	2	||||	|H| |SH|	||||	|14|E|S2|	|3|T|S1|	|H|SC *|SH|
		Massachusetts has one occurrence of *S. pauciflora* var. *pauciflora* in the state and considers this taxon as distinct from *S. pauciflora* var. *caroliniana*.					
Scleria reticularis Michx. (14)	1	||||	|1| |S1|	||||	|60|WL|S4|	|3|T|S1|	|1|E|S1|
		GRank = G3G4. Species concept used here does not include the more southern *S. muhlenbergii*.					
Scleria triglomerata Michx. (14)	2	||||	||||	||||	|1|E|S1|	|2|T|S1|	|1|E|S1|
Scleria verticillata Muhl. (14)	4	||||	||||	||||	||||	||||	H|SC *|SH|
Trichophorum clintonii (Gray) S.G. Smith (1) *Scirpus clintonii* (14)	2	|5-10| |S2|	||||	||||	||||	||||	||||
DIAPENSIACEAE							
Diapensia lapponica L. (14)	3*	|13| |S2|	|+|T|S3|	|1|E|S1|*	||||	||||	||||
		Disjunct occurrence in Chittenden County, Vermont.					
DROSERACEAE							
Drosera anglica Hudson (14)	2	|3|E|S1|	||||	||||	||||	||||	||||
Drosera linearis Goldie (14)	2	|1|E|S1|	||||	||||	||||	||||	||||

NAME	Div	ME	NH	VT	MA	RI	CT
DRYOPTERIDACEAE							
Dryopteris filix-mas Schott (12)	2	|2|E|S1|	||||	|7|T|S2|	||||	||||	||||
Gymnocarpium jessoense (Koidzumi) Koidzumi ssp. parvulum Sarvela (12)	4	|||| Probably introduced in Connecticut, but currently not extant there.	||||	|H| |SH|	||||	||||	||| SE|
Woodsia alpina (Bolton) Gray (12)	2	|3|T|S1|	||||	|4|E|S1|	||||	||||	||||
EBENACEAE							
Diospyros virginiana L. (14)	2	|||| There is some question as to whether Connecticut's single occurrence is native. The point is moot, however, because only a single individual is extant and the species is dioecious.	||||	||||	|||SE|	||||	|1|SC|S1|
ELAEAGNACEAE							
Shepherdia canadensis (L.) Nutt. (14)	3*	|1|E|S1|* Disjunct in Somerset County, Maine.	||||	|+| |S3|	||||	||||	||||
ELATINACEAE							
Elatine americana (Pursh) Arn. (11)	IND.	|||SU| More field work needed to determine status. There is taxonomic confusion regarding the New England specimens.	||||	||||	|2|E|S1|	|2|T|S1|	|H| |SH|

NAME	Div	ME	NH	VT	MA	RI	CT
EMPETRACEAE							
Empetrum nigrum L. (14)	3*	|+| |S4|	|+|T|S3|	|4| |S1|*	||||	||||	||||
		Disjunct occurrences in Chittenden, Orleans, and Washington Counties, Vermont.					
EQUISETACEAE							
Equisetum × mackaii (Newman) Brichan (12)	IND.	|H| |SH?|	|||SU|	|||SU|	||||	||||	|10+| |SU|
		More field study needed. FNA (Flora of North America Editorial Committee 1993) cites this taxon in Connecticut, Maine, New Hampshire, and Vermont, but says that specimens from Connecticut and New Hampshire have not been seen. Taxon is a hybrid between *E. hyemale* and *E. variegatum*. May be more common than previously thought.					
ERICACEAE							
Arctostaphylos alpina (L.) Sprengel (14)	2	|1|T|S1|	|4|T|S1|	||||	||||	||||	||||
Harrimanella hypnoides (L.) Coville (14)	2	|2|E|S1|	|4|T|S2|	||||	||||	||||	||||
Cassiope hypnoides (11) [NH]							
Loiseleuria procumbens (L.) Desvaux (14)	2	|1|E|S1|	|10|T|S2|	||||	||||	||||	||||
Lyonia mariana (L.) D. Don (14)	4	||||	||||	||||	||||	|H|SH|SH|	|H|SC *|SH|

NAME	Div	ME	NH	VT	MA	RI	CT
Phyllodoce caerulea (L.) Bab. (14)	2	|2|E|S1|	|8|T|S2|	||||	||||	||||	||||
Rhododendron lapponicum (L.) Wahlenb. (14)	2	|2|E|S1|	|7|SC|S3|	||||	||||	||||	||||
Rhododendron maximum L. (14)	3*	|6|T|S1|*	|5|T|S2|	|7|T|S2|*	|7|T|S2|	|10+| |S3|	|10| |S3|
		Disjunct in Caledonia and Orleans Counties, Vermont. Documented decline of some occurrences in Maine.					
Rhododendron viscosum (L.) Torr. (14)	3*	|1|T|S1|*	|+|T|S3|	|H| |SH|	|+| |S5|	|+| |S4|	|+| |S4|
		Disjunct in Oxford County, Maine.					
Vaccinium boreale I.V. Hall & Aald. (14)	1	|3|E|S1|	|11| |S3|	|3| |S1|	||||	||||	||||
		GRank = G3.					
Vaccinium vitis-idaea L. var. minus Lodd. (11) *Vaccinium vitis-idaea* ssp. *minus* (15) [MA]	3*	|+| |S4|	|+| |S4|*	|4| |S1|	|2|E|S1|*	||||	|H|SC *|SH|
		Disjunct in Berkshire County, Massachusetts, and in Cheshire County, New Hampshire.					
ERIOCAULACEAE							
Eriocaulon parkeri Robinson (14)	1	|25| |S3|	||||	||||	|<4|E|S1|	||||	|6|E|S1|
		GRank = G3; Fed. code = 3C.					

NAME	Div	ME	NH	VT	MA	RI	CT
EUPHORBIACEAE							
Crotonopsis elliptica Willd. (14)	4	||||	||||	||||	||||	||||	|H|SC *|SH|
Euphorbia glyptosperma Engelm. (14) *Chamaesyce glyptosperma* (15) [MA]	IND.	|||SU| Considered introduced into several states; tracking as a native species in Vermont only recently begun.	|||SU|	|?| |S1|	|||SE|	||||	||||
FABACEAE							
Astragalus alpinus L. var. brunetianus Fern. (14)	1	|27| |S2| GRank = G5T2T3.	|H| |SH|	|H| |SX|	||||	||||	||||
Astragalus canadensis L. (14)	2	||||	||||	|9|T|S2|	||||	||||	||||
Astragalus eucosmus B. L. Robinson (14)	4	|H| |SX|	||||	||||	||||	||||	||||
Astragalus robbinsii (Oakes) A. Gray var. jesupii Eggleston (14)	1	|||| GRank = G5T1; Fed. code = LE.	|2|E|S1|	|1|E|S1|	||||	||||	||||
Astragalus robbinsii (Oakes) A. Gray var. minor (Hook.) Barneby (14)	2	|H| |SX|	||||	|7| |S2|	||||	||||	||||
Astragalus robbinsii (Oakes) A. Gray var. robbinsii (14)	4	|||| GRank = G5TX; Fed. code = 3A.	||||	|H| |SX|	||||	||||	||||
Desmodium canescens (L.) DC. (14)	2	||||	||||	||||	|5|WL|S1|	||||	|8| |S3|

NAME	Div	ME	NH	VT	MA	RI	CT
Desmodium cuspidatum (Muhl.) Loudon (14)	2	||||	|H| |SH|	|3|E|S1|	|3|WL|S1|	||||	|||SU|
Desmodium glabellum (Michx.) DC. (14)	2	||||	||||	||||	||||	||||	|5|SC|S1|
Desmodium humifusum (Muhl.) Beck (14)	1	||||	||||	||||	|2|E|S1|	||||	|2|E|S1|
		GRank = G1G2Q; Fed. code = C2. Recent research suggests this species is a hybrid of *D. paniculata* × *D. rotundifolium*.					
Desmodium sessilifolium (Torr.) T. & G. (14)	2	||||	||||	||||	||||	|1|E|S1|	|H|SC *|SH|
Lathyrus ochroleucus Hook. (14)	2	||||	||||	|8| |S2|	||||	||||	||||
Lespedeza repens (L.) Barton (14)	2	|||\`	||||	||||	|1?| |S?|	||||	|1|SC|S1|
Lespedeza stuevei Nutt. (14)	IND.	||||	||||	|H| |SH|	|19| |S3?|	|||SU|	|||SU|
		Current status uncertain.					
Lupinus perennis L. (14)	3*	|H| |SX	|21|T|S1|*	|2|T|S1|*	|+|WL|S3|*	|8|C|S2|*	|12| |S2|*
		Documented decline in Connecticut, Rhode Island, Massachusetts, New Hampshire, and Vermont. Note: most New Hampshire occurrences are small and isolated, primarily on roadsides and power lines.					
Oxytropis campestris (L.) DC. var. johannensis Fern. (14)	1	|8|T|S1S2|	||||	||||	||||	||||	||||
		GRank = G5?T3; Fed. code = 3C.					

NAME	Div	ME	NH	VT	MA	RI	CT
Phaseolus polystachios (L.) BSP. (14) *Phaseolus polystachios* var. *aquilonius* (11) [CT]	4	||||	||||	||||	||||	||||	|H|SC *|SH| Reported from all of New England in Gleason and Cronquist (1991), but we have seen specimens only from Connecticut.
Strophostyles umbellata (Muhl.) Britton (14)	4	||||	||||	||||	||||	|H|SH|SH|	||||
FUMARIACEAE							
Corydalis aurea Willd. (14)	2	||||	|H| |SX|	|6|T|S2|	||||	||||	||||
Corydalis flavula (Raf.) DC. (14)	2	||||	||||	||||	||||	||||	|4|T|S1|
Dicentra canadensis (Goldie) Walp. (14)	3*	|3|T|S1|*	|11|T|S2S3|	|+| |S4|	|+| |S4|	||||	|6|T|S2| Disjunct in Franklin and Penobscot Counties, Maine.
GENTIANACEAE							
Gentiana andrewsii Griseb. (14)	2	||||	|2|T|S1|	|5|T|S1|	|2|T|S1|	|H|SH|SH|	|||SU| Specimens of this species and *G. clausa* should be examined closely due to similarity.
Gentianella amarella (L.) Boerner (14) *Gentiana amarella* (11) [VT]	2	|1|E|S1|	||||	|H|T|SH|	||||	||||	||||
Gentianella quinquefolia (L.) Small (14) *Gentiana quinquefolia* (11) [CT,MA]	2	|H| |SH|	|H| |SH|	|2|T|S1|	|12+|WL|S2|	||||	|2|E|S1

NAME	Div	ME	NH	VT	MA	RI	CT
Lomatogonium rotatum (L.) Fries (14)	2	|9| |S1S2|	||||	||||	||||	||||	||||
Sabatia campanulata (L.) Torr. (14)	2	||||	||||	||||	|5|E|S1|	||||	||||
Sabatia dodecandra (L.) BSP. (14)	4	||||	||||	||||	||||	||||	|H|SC *|SH|
Sabatia kennedyana Fern. (14)	1	||||	||||	||||	|140|SC|S3|	|4|E|S1|	||||
		GRank = G3. Massachusetts has the largest number of occurrences globally.					
Sabatia stellaris Pursh (14)	2	||||	||||	||||	|1|E|S1|	|4|T|S1|	|2| |S1|
		Species has not been seen in Massachusetts in recent years.					
GROSSULARIACEAE							
Ribes rotundifolium Michx. (14)	IND.	||||	||||	||||	|1|WL|S1|	||||	|H|SC *|SH|
		Specimen from Massachusetts appears valid, but it is unknown whether this species is truly native there.					
HALORAGACEAE							
Myriophyllum pinnatum (Walter) BSP. (14)	IND.	||||	||||	||||	|6|SC|S2?|	|1|T|S1|	|H|SC *|SH|
		More field study needed to determine status.					
Myriophyllum verticillatum L. (14)	IND.	|+?| |SU|	|||SU|	|5| |S1|	|1|T|S1|	||||	|||SU|
		More field study needed to determine status.					

NAME	Div	ME	NH	VT	MA	RI	CT
HAMAMELIDACEAE							
Liquidambar styraciflua L. (14)	2	||||	||||	||||	||||	||||	|8|SC|S2S3|
		This species has been introduced into some states. It is difficult to determine which Connecticut occurrences are native and which are introduced.					
HIPPURIDACEAE							
Hippuris vulgaris L. (14)	2	|||SU|	|2|T|S3|	|2|E|S1|	||||	||||	||||
HYDROPHYLLACEAE							
Hydrophyllum canadense L. (14)	2	||||	||||	|1|T|S1|	|2|E|S1|	||||	||||
HYMENOPHYLLACEAE							
Trichomanes intricatum Farrar (12)	1	||||	|1||S1|	|||SU|	|3|T|S1|	||||	|3|SC|S1|
		GRank = G3G4.					
IRIDACEAE							
Sisyrinchium mucronatum Michx. (14)	2	|<5?||S1?|	|H||SH|	|H||SH|	|3|T|S1|	||||	|||SU|
		Not tracked by the Connecticut Natural Diversity Data Base. The Maine Natural Areas Program began tracking this species in 1996.					
ISOËTACEAE							
Isoëtes acadiensis Kott (12)	1	|1||S1|	|1||S1	||||	|3|E|S1|	||||	||||
		GRank = G3?.					

NAME	Div	ME	NH	VT	MA	RI	CT
Isoëtes × eatonii Dodge (12) *Isoëtes eatonii* (13) [NH]	IND.	||||	|H||SH|	||||	|I| |SU|	||||	|4| |S1|
		GRank = G2Q; Fed. code = 3B. GRank is for synonym, *I. eatonii*. Sterile hybrid of *I. engelmannii* with *I. echinospora*.					
Isoëtes × foveolata A.A. Eaton ex Dodge (12)	IND.	||||	||||	||||	|H| |SH|	||||	|H|SC *|SH|
		Current status unknown; hybrid of *I. engelmannii* with *I. tuckermanii*.					
Isoëtes lacustris L. (12) *Isoëtes macrospora* (11) [CT,MA,ME,NH,VT]	IND.	| +?||SU|	|1|T|S1|	|?||S2?|	|1|E|S1|	| |SU|	|1||SU|
		More field study needed. FNA (Flora of North America Editorial Committee 1993) says that North American plants of *I. lacustris* have been segregated as *I. macrospora* by some authors, but that the two taxa cannot be distinguished reliably from each other except on the basis of geography.					
Isoëtes prototypus D.M. Britton (12)	1	|1| |S1|	||||	||||	||||	||||	|||
		GRank = G2G3.					
Isoëtes riparia Engelmann ex A. Braun (12) *Isoëtes riparia* var. *canadensis* (11) [RI]	2	|H| |SH|	|2|T|S2|	|2| |S1|	|H| |SH|	|4|C|S1|	| |SU|
JUGLANDACEAE Juglans cinerea L. (14)	IND.	|+| |SU|	|+| |S3?|	|+| |S4|	|+| |S4|	|+| |SU|	|+| |SU|
		Fed. code = C2. Declining in some New England states because of the fungus, *Sirococcus clavigignenti-juglandacearum*, and therefore should be monitored.					

NAME	Div	ME	NH	VT	MA	RI	CT
JUNCACEAE							
Juncus alpinus *auct. non* Vill. (13) *Juncus alpinoarticulatus* (14) [ME,NH]	2	|7-10|T|S2|	|1||S1|	|8| |S2|	||||	||||	||||
Juncus biflorus Ell. (14)	2	||||	||||	||||	|8|E|S2|	||||	||||
Juncus debilis A. Gray (14)	2	||||	||||	||||	|1|E|S1|	|3|C|S1|	|H|SC *|SH|
Juncus × oronensis Fern. (14) *Juncus oronensis* (11)	IND.	|H| |SH?|	||||	||||	||||	|||	||||
		Name is based on two historic specimens occurring with the parents (*J. tenuis* × *J. vaseyi*). Status uncertain. Not tracked by the Maine Natural Areas Program.					
Juncus pervetus Fern. (11)	IND.	||||	||||	||||	|H| |SX|	||||	||||
		Taxonomic status unclear. Fernald (1950) says native at one site in Massachusetts, but Gleason and Cronquist (1991) include the taxon under the European *Juncus subnodulosus*.					
Juncus stygius L. var. americanus Buch. (14)	2	|9| |S2|	||||	||||	||||	||||	||||
Juncus subtilis E. Meyer (14)	IND.	|H| |SU|	||||	||||	||||	||||	||||
Juncus torreyi Cov. (14)	2	|||SU|	||||	|2|E|S1|	|||SE|	||||	||||
Juncus trifidus L. (14)	3*	|+| |S3S4|	|+| |S3S4|	|5| |S1|*	||||	||||	||||
		Disjunct occurrences on high peaks in Chittenden, Windsor, Washington, and Lamoille Counties, Vermont.					

NAME	Div	ME	NH	VT	MA	RI	CT
Juncus vaseyi Engelm. (14)	2	|1| |S1|	||||	|1| |S1|	||||	||||	||||
Luzula confusa Lindeberg (14)	2	|1|E|S1|	|H|E|SH|	||||	||||	||||	||||
Luzula spicata (L.) DC. (14)	2	|1|E|S1|	|7|T|S3|	|1| |S1|	||||	||||	||||
JUNCAGINACEAE							
Triglochin gaspense Lieth & D. Löve (15)	4	|H| |SH|	||||	|||	||||	||||	||||
		GRank = G2; Fed. code = C2. This taxon has been separated from *T. maritimum*. (See Löve and Lieth 1961).					
LAMIACEAE							
Agastache nepetoides (L.) Kuntze (14)	2	||||	||||	|1|T|S1|	||||	||||	|1|SC|S1|
Agastache scrophulariifolia (Willd.) Kuntze (14)	2	||||	||||	|1|T|S1|	|H| |SH|	||||	|2|SC|S1|
Blephilia ciliata (L.) Benth. (14)	2	||||	||||	|H| |SH|	|1|E|S1|	||||	|H| |SH|
Blephilia hirsuta (Pursh) Benth. (14)	2	||||	||||	|2|T|S1|	|7|E|S1|	||||	|1|SC|S1|
Blephilia hirsuta (Pursh) Benth. var. glabrata Fern. (11)	IND.	||||	||||	|H| |SH|	||||	||||	||||
		GRank = G4?T1Q. This taxon is a Vermont endemic described by Fernald. It has never been re-collected.					

NAME	Div	ME	NH	VT	MA	RI	CT
Dracocephalum parviflorum Nutt. (14)	2	|||SE|	||||	|1|T|S1|	|||SE|	|||SE|	|||SE|
		Recent searches have not re-located the Vermont occurrence. It was last seen in 1983.					
Lycopus rubellus Moench (14)	2	||||	|H||SH|	|1||S1|	|2|T|S1|	|1||SU|	|2||SU|
Monarda punctata L. var. villicaulis Pennell (14)	2	||||	||||	|2||S1|	|||SE|	||||	|||SU|
Pycnanthemum clinopodioides T. & G. (14)	IND.	||||	||||	||||	|1|E|S1|	||||	3|E|S1|
		GRank = G2. Taxonomic confusion. Difficult to distinguish and suspected by some botanists to be of hybrid origin. More field and laboratory work needed.					
Pycnanthemum torrei Benth. (14)	IND.	||||	|1|E|S1|	||||	||||	||||	|2|E|S1|
		GRank = G2. Taxonomic confusion. Difficult to distinguish and suspected by some botanists to be of hybrid origin. More field and laboratory work needed.					
Scutellaria integrifolia L. (14)	2	||||	||||	||||	|H||SX|	||||	|1|SC|S1|
Scutellaria leonardii Epling (14) *Scutellaria parvula* var. *leonardi* (11) [MA,ME]	2	|H||SH|	||||	||||	||WL|SU|	||||	|1|E|S1|
Scutellaria parvula Michx. var. parvula (14)	2	|||SU|	||||	|11||S2|	||||	||||	||||
Stachys hyssopifolia Michx. (14)	3*	||||	||||	||||	|59|WL|S4|	|1|E|S1|	|2|E|S1|*
		Disjunct in Hartford County, Connecticut.					

NAME	Div	ME	NH	VT	MA	RI	CT
Stachys pilosa Nutt. (13) *Stachys palustris* ssp. *pilosa* (1) [MA,ME]	IND.	|||SE|	| |SU|	| |SU|	|||SU|	||||	||||
		Status unclear for this and closely related taxa.					
Stachys tenuifolia Willd. (14) *Stachys tenuifolia* var. *platyphylla* (11) [NH]	IND.	| |SE|	|||SU|	||||	| |SU|	|H| |SH|	|H|SC *|SH|
		More field study needed. Recorded for New England in Seymour (1969) and the Maine checklist (Campbell et al. 1995), but Gleason and Cronquist(1991) give a more western range for this and closely related taxa.					
Trichostema brachiatum L. (15) *Isanthus brachiatus* (14) [CT]	2	||||	||||	|H| |SH|	|3|E|S1|	||||	|H|SC *|SH|
LEMNACEAE							
Lemna valdiviana Philippi (14)	IND.	||||	|1|E|S2|	||||	| |SU|	||||	| |SU|
		Not enough information on extant occurrences. Identity of plants in certain reports has been questioned. More field work needed.					
Wolffiella gladiata (Hegelm.) Hegelm. (17) *Wolffiella floridana* (14)	2	||||	||||	||||	|1| |S1|	||||	||||
		Species is being recommended for state endangered species list in Massachusetts in 1997.					
LENTIBULARIACEAE							
Pinguicula vulgaris L. (14)	2	|1| |S1|	|2|E|S2|	|1| |S1|	||||	||||	||||
		Unknown from Maine until 1996.					

NAME	Div	ME	NH	VT	MA	RI	CT
Utricularia biflora Lam. (14)	2	||||	||||	||||	|7|T|S2|	|2|T|S1|	|H|SC *|SH|
		Treated as a synonym of *U. gibba* in Kartesz (1994).					
Utricularia fibrosa Walter (14)	2	||||	||||	||||	|6|T|S2|	||||	|H|SC *|SH|
Utricularia inflata Walter (14)	IND.	||||	||||	||||	|2| |S1|	||||	||||
		Indigenous status in Massachusetts is uncertain.					
Utricularia resupinata B. D. Greene (14)	2(a)	|2|T|S1|	|||SU|	|5|T|S1|	|~8|WL|S2|	|4|T|S1|	|1|SC|S1|
		Some occurrences contain small numbers of plants.					
Utricularia subulata L. (14)	2	||||	||||	||||	|10|SC|S3|	|4|C|S1|	||||
LILIACEAE							
Chamaelirium luteum (L.) A. Gray (14)	2	||||	||||	||||	|3-4|E|S1|	||||	5|E|S1|
Melanthium hybridum Walter (14)	4	||||	||||	||||	||||	||||	|H|SC *|SH|
Tofieldia glutinosa (Michx.) Pers. (14)	3*	|+| |S3S4|	|4|T|S1|*	|4|T|S1|*	||||	||||	||||
		Disjunct in Cheshire, Sullivan, and Grafton Counties, New Hampshire, and in Windsor and Caledonia Counties, Vermont.					
Zigadenus elegans Pursh var. glaucus (Nutt.) Preece (14) *Zigadenus glaucus* (11) [VT]	4	||||	||||	|H||SH|	||||	||||	||||

NAME	Div	ME	NH	VT	MA	RI	CT
LIMNANTHACEAE							
Floerkea proserpinacoides Willd. (14)	2	||||	||||	|H| |SH|	|H| |SX|	||||	|4|E|S1|
LINACEAE							
Linum medium (Planchon) Britton var. texanum (Planchon) Fern. (14) *Linum medium* [ME,VT]	2	|||SU|	||||	|H||SH|	|4|T|S1|	|| |SU|	|| |SU|
Linum sulcatum Riddell (14)	2	||||	||||	|H| |SH|	|H| |SX|	|1|E|S1|	|1|SC|S1|
LYCOPODIACEAE							
Diphasiastrum × sabinifolium (Willd.) Holub (12) *Lycopodium sabinifolium* (14) [NH,VT]	2	|5|T|S1|	|||SU|	|3||S1	||||	||||	||||
		According to FNA (Flora of North America Editorial Committee 1993) this hybrid between *D. sitchense* and *D. tristachyum* is highly variable.					
Diphasiastrum sitchense (Rupr.) Holub (12) *Lycopodium sitchense* (14) [NH,VT]	2	|1|E|S1|	|||SU|	|H|T|SH|	||||	||||	||||
Huperzia appalachiana Beitel & Mickel (12)	IND.	|7| |S2|	|| |SU|	|?| |S1|	|1?|E|S1|	||||	||||
		GRank = G3. Recent FNA (Flora of North America Editorial Committee 1993) treatment suggests high elevation alpine occurrences are this taxon, but not all occurrences have been verified. Massachusetts' only known occurrence is suspected to be a hybrid (*H. appalachiana* × *H. lucidulum*).					

NAME	Div	ME	NH	VT	MA	RI	CT
Huperzia selago (L.) Bernhardi *ex* Schrank & Martius (12) *Lycopodium selago* (14) [CT,NH,VT]	IND.	|1| |S1|	|?||SU|	|?||S1|	|1|E|S1	||||	|H|SC *|SH|
		Recent FNA (Flora of North America Editorial Committee 1993) treatment suggests lower elevation plants are this taxon, but not all occurrences have been verified.					
Lycopodiella alopecuroides (L.) Cranfill (12) *Lycopodium alopecuroides* (14) [CT,MA,RI]	2	||||	||||	||||	|1|E|S1|	|1|E|S1|	|H|SC *|SH|
Pseudolycopodiella caroliniana (L.) Holub (12) *Lycopodium carolinianum* (14) [MA]	4	||||	||||	||||	|H||SX|	||||	||||
		This species was last seen in New England on Mt. Toby in Massachusetts in 1976, but is believed to be extirpated from this site.					
LYGODIACEAE							
Lygodium palmatum (Bernh.) Swartz (12)	3*	||||	|H| |SX|	|1|E|S1|*	|22|SC|S3|	|6|C|S1|	|11|SC|S2|*
		Documented decline in Connecticut. Disjunct occurrence in Lamoille County, Vermont.					
LYTHRACEAE							
Cuphea viscosissima Jacq. (14)	4	||||	||||	||||	|H| |SX|	|H| |SH|	|H| |SH|
		Sorrie (1991) considers this species "doubtfully native" in Massachusetts.					

NAME	Div	ME	NH	VT	MA	RI	CT
Lythrum alatum Pursh var. alatum (14)	IND.	| | |SE|	| | |SU|	| | |SE|	| | |SE|	| | |SU|	|H| |SH|
		Some occurrences in southern New England are thought to be native, but the species is adventive northward. Vermont occurrences are introduced and no longer extant.					
Rotala ramosior (L.) Koehne (14)	2	| | | |	| | | |	| | | |	|1|E|S1|	|1|E|S1|	|5|E|S1|
MAGNOLIACEAE							
Magnolia virginiana L. (14)	2	| | | |	| | | |	| | | |	|3|E|S1|	| | | |	| | | |
MELASTOMATACEAE							
Rhexia mariana L. (14)	2	| | | |	| | | |	| | | |	|8|E|S1|	| | | |	| | | |
MORACEAE							
Morus rubra L. (14)	2	| | | |	| | | |	|2|T|S1|	|3|E|S1|	| | | |	|3|E|S1|
		Some introduced populations occur in Vermont and other New England states.					
NAJADACEAE							
Najas guadalupensis (Sprengel) Magnus (14)	IND.	|H| |SH|	| | | SU|	|5| |S1|	| |WL|SE|	|2|T|S1|	|1|SC|S1|
		More field study needed. Considered introduced into at least one state (Massachusetts). May be more common than previously recorded.					

NAME	Div	ME	NH	VT	MA	RI	CT
NYMPHAEACEAE							
Nuphar lutea (L.) Sm. ssp. advena (Ait.) Kartesz & Gandhi (1) *Nuphar advena* (14) [CT,NH,VT]	IND.	|1-5| |S2?|	|1||S1|	|H||SH|	||||	||||	|H||SH|
		Relatively few occurrences of this taxon, but some occurrences include entire estuaries.					
Nymphaea leibergii Morong (13) *Nymphaea tetragona* (14)	2	|6| |S1|	||||	||||	||||	||||	||||
Nymphaea odorata Aiton ssp. tuberosa (Paine) Wiersema & Hellquist (13) *Nymphaea odorata* var. *tuberosa* [VT] *Nymphaea tuberosa* (11) [MA]	IND.	||||	||||	|?||SU|	|||SE|	||||	|H|SC *|SH|
		More field study needed.					
ONAGRACEAE							
Epilobium anagallidifolium Lam. (15) *Epilobium alpinum* (14)	2	|2|T|S1|	|1| |S1|	||||	||||	||||	||||
Epilobium hornemannii Reichb. (14) *Epilobium hornemanni* (11) [ME,NH]	2	|3|T|S1|	|6|T|S2|	||||	||||	||||	||||
Ludwigia polycarpa Short & Peter (14)	2	||||	||||	|2|E|S1|	|7|T|S2|	||||	|H|SC *|SH|
Ludwigia sphaerocarpa Elliott (14)	2	||||	||||	||||	|2|T|S1|	|1|E|S1|	|2|E|S1|
Oenothera fruticosa L. (14)	IND.	|| |SE|	||||	||||	|| |SE?|	|1+| |S1|	|H|SC *|SH|
		More field study needed to determine status in New England. Uncertainty exists regarding its status as a native species.					

NAME	Div	ME	NH	VT	MA	RI	CT
OPHIOGLOSSACEAE							
Botrychium lunaria (L.) Swartz (12)	2	|3|E|S1|	|H| |SH|	|H|E|SH|	| |SR|	|||	|||
		FNA (Flora of North America Editorial Committee 1993) reports this species from Massachusetts, but we have not seen specimens.					
Botrychium minganense Victorin (12)	IND.	|H?| |SH?|	| |SR|	| |SR|	|||	|||	|||
		FNA (Flora of North America Editorial Committee 1993) reports this taxon from New Hampshire and Vermont, but we have not seen specimens.					
Botrychium oneidense (Gilbert) House (12)	IND.	| |SU|	| |SU|	| |SU|	| |SU|	| |SU|	| |SU|
		Difficult taxon to distinguish. FNA (Flora of North America Editorial Committee 1993) attributes this to every state in New England.					
Botrychium rugulosum W. H. Wagner (12)	IND.	||||	||||	| |SU|	||||	||||	| |SU|
		GRank = G3. Many older Vermont collections of this taxon exist. Taxon is not in FNA (Flora of North America Editorial Committee 1993) for Connecticut, but one specimen exists from that state. Difficult to distinguish from *B. multifidum* or *B. dissectum*. More field work is needed.					
Ophioglossum pusillum Raf. (12) *Ophioglossum vulgatum* (14) [CT]	3*	|+?| |S3?|	| |SU|	|+| |S3|	|6|T|S2|*	|1|E|S1|*	|3|T|S1|*
		Documented decline in Massachusetts, Connecticut, and Rhode Island.					
ORCHIDACEAE							
Amerorchis rotundifolia Banks (13) *Orchis rotundifolia* (14)	2	|6|T|S1|`	||||	|H| |SH|	||||	||||	||||

NAME	Div	ME	NH	VT	MA	RI	CT
Aplectrum hyemale (Muhl.) Torr. (14)	2	||||	||||	|1|T|S1|	|3|E|S1|	||||	|H|SC *|SH|
Arethusa bulbosa L. (14)	3*	|+| |S3S4|	|4|E|S1|	|6|T|S2|*	|16|T|S2|*	|5|E|S1|*	|1|E|S1|*
		Documented decline in Connecticut, Massachusetts, Rhode Island, and Vermont.					
Calypso bulbosa (L.) Oakes (14)	3*	|+| |S3S4|	|H|E|SX|	|7|T|S2|*	||||	||||	||||
		Documented decline in Vermont.					
Corallorhiza odontorhiza (Willd.) Nutt. (14)	3*	|2|E|S1|*	|3|E|S1|*	|6|T|S2|	|13|SC|54|	|3|T|S1|	|10| |S3|
		Disjunct occurrences in Strafford and Carroll Counties, New Hampshire and in York and Oxford Counties, Maine.					
Cypripedium arietinum R. Br. (14)	1	|5|T|S1|	|2|E|S1|	|18|T|S2|	|1|E|S1|	||||	|H|SC *|SH|
		GRank = G3; Fed. code = 3C.					
Cypripedium parviflorum Salisb. var. makasin (Farwell) Sheviak (13)	IND.	||||	|||SU|	|||SU|	|2?| |SU|	|||SU|	|||SU|
		Difficult to distinguish. Recent taxonomic work splits yellow lady's slippers into three taxa; the disposition of this taxon in New England is unclear.					
Cypripedium parviflorum Salisb. var. parviflorum (13) *Cypripedium calceolus* var. *parviflorum* (14) [CT,MA] *Cypripedium parviflorum* (15) [ME,NH,RI,VT]	IND.	|+?||S3?|	|2|E|S1|	||S3|	2?|E|S1|	||SU|	||||
		Difficult to distinguish. Recent taxonomic work splits yellow lady's slippers into three taxa; the disposition of this taxon in New England is unclear.					

NAME	Div	ME	NH	VT	MA	RI	CT
Cypripedium parviflorum Salisb. var. pubescens (Willd.) Knight (13) *Cypripedium calceolus* var. *pubescens* (14) [CT] *Cypripedium pubescens* (15) [MA,ME,NH,RI,VT]	IND.	|+?||S3?|	|6|T|S2|	|+||S3|	|+?|WL|S3|	|4|T|S1|	|||SU|
		Difficult to distinguish. Recent taxonomic work splits yellow lady's slippers into three taxa; the disposition of this taxon in New England is unclear.					
Cypripedium reginae Walter (14)	3*	|26| |S2S3|	|5|SE|S1|	|+| |S3|	|18|SC|S3|*	||||	|3|E|S1|*
		Documented decline in Connecticut and Massachusetts.					
Galearis spectabilis (L.) Raf. (15) *Orchis spectabilis* (14) [RI,VT]	3*	|2|T|S1|*	|4|T|S2|	|+||S4|	|+| |S3|	|1|SE|S1|	|+| |S3|
		Disjunct in Oxford and Somerset Counties, Maine. Recent field work seems to indicate a decline in southern New England occurrences.					
Goodyera oblongifolia Raf. (14)	2	|5|E|S1|	||||	||||	||||	||||	||||
Isotria medeoloides (Pursh) Raf. (14)	1	|17|E|S2|	|+|E|S2|	|H|E|SH|	|3|E|S1|	|1|E|S1|	|1|E|S1|
		GRank = G2G3; Fed. code = LT. The majority of occurrences of this globally rare species are in New Hampshire and Maine.					
Liparis liliifolia Rich. (14)	2	||||	|H| |SX|	|1|T|S1|	|8+|WL|S2|	|2|T|S1|	|2|E|S1|
Listera auriculata Wieg. (14)	1	|7| |S1|	|3|E|S1|	|1|E|S1|	||||	||||	||||
		GRank = G3.					
Listera australis Lindl. (14)	2	||||	||||	|2|E|S1|	||||	||||	||||

NAME	Div	ME	NH	VT	MA	RI	CT
Listera cordata (L.) R. Br. (14)	3*	|+| |S3S4|	|8|T|S2|	|+| |S3|	|1|E|S1|*	|H|SH|SH	| | | |
		Disjunct in Barnstable County, Massachusetts.					
Malaxis bayardii Fern. (11)	1	| | | |	| | | |	|H| |SH|	|2-3|E|S1|	| | | |	|H| |SH|
		GRank = G2?. This species is similar to *Malaxis unifolia*. Specimens should be looked at critically.					
Platanthera ciliaris (L.) Lindl. (15) *Habenaria ciliaris* (14)	2	| | | |	| | | |	| | | |	|H| |SX|	|2|E|S1|	|8|T|S2|
Platanthera cristata (Michx.) Lindl. (15) *Habenaria cristata* (14)	2	| | | |	| | | |	| | | |	|1?|E|S1|	| | | |	| | | |
		Massachusetts occurrence has not been seen in recent years and is likely now extirpated.					
Platanthera leucophaea (Nutt.) Lindl. var. leucophaea (15) *Habenaria leucophaea* (14)	1	|1|E|S1|	| | | |	| | | |	| | | |	| | | |	| | | |
		GRank = G2; Fed. code = LT.					
Spiranthes casei Catling & Cruise (14)	IND.	| | |SU|	|2|E|S1|	|?| |SU|	| | | |	| | | |	| | | |
		Further study needed.					
Spiranthes × intermedia Ames (20)	IND.	| | |SU|	| | |SU|	| | |SU|	| | |SU|	| | |SU|	| | |SU|
		Luer (1975) shows this taxon as present in all New England states. It is reportedly (Sorrie 1991) a hybrid of *S. lacera* var. *gracilis* × *S. vernalis*, but *S. vernalis* does not occur in Maine. Further study needed.					
Tipularia discolor (Pursh) Nutt. (14)	2	| | | |	| | | |	| | | |	|7|E|S2|	| | | |	| | | |

NAME	Div	ME	NH	VT	MA	RI	CT
Triphora trianthophora (Swartz) Rydb. (14)	2(a)	|7|T|S1S2|	|10|T|S2|	|3|T|S1|	|2|E|S1|	||||	|H|SC *|SH|
		Small population sizes of some occurrences are cause for concern. Furthermore, entire occurrences of this species may not emerge every year.					
OXALIDACEAE							
Oxalis violacea L. (14)	2	||||	||||	||||	|5|T|S1|	|1|E|S1|	|5|SC|S1|
POACEAE							
Agrostis mertensii Trin. (14) *Agrostis borealis* (11) [NH]	2	|6| |S2|	|7||S3|	|5| |S1|	||||	||||	||||
Ammophila champlainensis Seymour (29)	IND.	||||	||||	|2|E|S1|	||||	||||	||||
		GRank = G1Q. Taxonomic study to determine if this is a good species or a variety of *A. breviligulata* is in progress.					
Amphicarpum purshii Kunth (14)	2	||||	||||	||||	|1|E|S1|	||||	||||
Aristida basiramea Engelm. (14)	IND.	|2| |S1|	|1| |SU|	|?| |SU|	||||	||||	||||
		May be more common than originally thought. More field work needed.					
Aristida purpurascens Poiret (14)	2	||||	||||	||||	|14|T|S2S3|	|3|T|S1|	|H| |SH|
Aristida tuberculosa Nutt. (14)	2	||||	|2|E|S1|	||||	|8|SC|S3|	||||	|5|T|S1|
Bouteloua curtipendula (Michx.) Torr. (14)	2	||||	||||	||||	||||	||||	|1|E|S1|

NAME	Div	ME	NH	VT	MA	RI	CT
Calamagrostis canadensis (Michx.) Beauv. var. langsdorfii (Link) Inman (15) *Calamagrostis nubila* (11) [NH]	4	||||	|H||SX|	||||	||||	||||	||||
GRank = GHQ. GRank applies to synonym *C. nubila*. Last collection at Lake of the Clouds by Boott in 1862.							
Calamagrostis pickeringii A. Gray (14)	2	|2|E|S1|	|9|T|S3|	|H| |SH|	|H| |SX|	||||	||||
Calamagrostis stricta (Timm) Koel. ssp. inexpansa (Gray) C. W. Greene (15) *Calamagrostis stricta* var. *inexpansa* [NH,VT] *Calamagrostis lacustris* (14) [NH]	2	|3|T|S1|	|7|E|SU|	|2|E|S1|	||||	||||	|1|SC|S1|
GRank = G3Q. GRank is for *C. lacustris*.							
Calamagrostis stricta (Timm) Koeler ssp. stricta (14) *Calamagrostis neglecta* (11) [NH]	2	|5|E|S1|	|5|T|S1|	||||	||||	||||	||||
Deschampsia atropurpurea (Wahlenb.) Scheele (14) *Vahlodea atropurpurea* (1) [ME]	2	|H||SH|	|3| |S2|	|H| |SH|	||||	||||	||||
Elymus villosus Muhl. (14)	2	||||	||||	|3| |S1|	|3|T|S2|	|||SU|	|||SU|
Eragrostis capillaris (L.) Nees (14)	IND.	|1|E|S1|	|||SU|	|?| |S2S3|	|4|WL|SU|	|||SU|	|||SU|
Adventive in gardens, roadsides, and railroads; difficult to determine which occurrences are native.							

NAME	Div	ME	NH	VT	MA	RI	CT
Hierochloe alpina (Swartz) Roemer & Schultes (14)	2	|5|T|S1|	|7| |S2|	|2|T|S1|	||||	||||	||||
Leptochloa fascicularis (Lam.) A. Gray var. maritima (Bicknell) Gleason (14) *Diplachne maritima* (11) [CT,MA,NH]	1	||||	|H||SH|	||||	|6|T|S2|	|H|H|SH|	|2|E|S1|
		GRank = G5T3T4.					
Leymus mollis (Trin.) Pilger var. mollis (14) *Elymus mollis* [MA,NH]	IND.	|+| |S4|	|H||SX|	||||	|2|E|S1|	||||	||||
		Confusion with the introduced *L. arenarius* makes this taxon's status unclear.					
Muhlenbergia capillaris (Lam.) Trin. (11)	2	||||	||||	||||	|H| |SX|	||||	|2|E|S1|
Muhlenbergia richardsonis (Trin.) Rydb. (14)	2	|2| |S1|	||||	||||	||||	||||	||||
Muhlenbergia sobolifera (Muhl.) Trin. (14)	3*	|1|E|SH|*	|2|T|S1|	|+| |S3|	|+| |S4|	|| |SU|	|+| |S3|
		The occurrence in Oxford County, Maine, is disjunct. State rank of "SH" for Maine is based on a 20-year cutoff date used by the Maine Natural Areas Program.					
Oryzopsis canadensis (Poiret) Trin. (14)	4	|H?| |SH?|	|H|E|SH|	||||	||||	||||	||||

NAME	Div	ME	NH	VT	MA	RI	CT
Panicum amarum Elliott (14)	2	||||	||||	||||	|||SE|	|1+||SU|	|7|T|S2|
		Massachusetts notes *P. amarum* var. *amarulum* as introduced in the state.					
Panicum flexile (Gattinger) Scribn. (14)	2	||||	||||	|2|E|S1|	||||	||||	|H||SH|
Panicum gattingeri Nash (11)	2	||||	||||	||||	|7|SC|S2?|	||||	|H||SH|
Panicum mattamuskeetense Ashe (11) *Panicum dichotomum* ssp. *mattamuskeetense*(13) *Dichanthelium mattamuskeetense* (31) [MA]	IND.	||||	||||	||||	|7?|E|SU?|	|H||SH|	||||
		May be overlooked on Cape Cod and the islands off the coast of Massachusetts. More field work needed.					
Panicum polyanthes Schultes (14) *Dichanthelium sphaerocarpon* var. *isophyllum* (15) [CT] *Dichanthelium polyanthes* [MA]	IND.	||||	||||	||||	|||SU|	||||	|H|SC *|SH|
		There is some confusion with this taxon and *P. sphaerocarpon*. More field work needed.					
Panicum rigidulum Bosc. var. pubescens (Vasey) Lelong (15) *Panicum longifolium* (11) [CT,MA,NH]	2	|||	|H||SH|	||||	|6|T|S2|	|||SU|	|H||SH|
Panicum scabriusculum Elliott (14) *Dichanthelium scabriusculum* (15) [CT,MA]	2	||||	||||	||||	|2|T|S1|	||||	|1|E|S1|

NAME	Div	ME	NH	VT	MA	RI	CT
Panicum sphaerocarpon Elliott (14) *Dichanthelium sphaerocarpon* (1) [MA,ME]	IND.	|||SU|	|H|E|SH|	|4| |S1|	|+||SU|	| | |SU|	| | |SU|
		Taxonomic confusion between this taxon and *P. polyanthes*. Further taxonomic and field work needed.					
Panicum stipitatum Nash (11)	4	| | | |	| | | |	| | | |	| | | |	| | | |	|H| |SH|
		State of Connecticut endangered species list cites *Panicum rigidulum* var. *elongatum* as this taxon.					
Paspalum laeve Michx. (14)	2	| | | |	| | | |	| | | |	|H| |SX|	| | | |	|2|E|S1|
Paspalum setaceum Michx. var. psammophilum (Nash) D. Banks (14)	2	| | | |	| | | |	| | | |	|7|WL|S2|	| | |SU|	|H|SC *|SH|
Phleum alpinum L. (14)	2	|8|T|S1|	|2|T|S2|	| | | |	| | | |	| | | |	| | | |
Poa glauca Vahl (14)	2	|<10| |SU|	|H|T|SH|	|1| |S1|	| | | |	| | | |	| | | |
Poa laxa Haenke ssp. fernaldiana (Nannf.) Hylander (13) *Poa fernaldiana* (14) [ME,NH,VT]	1	|1|E|S1|	|2|E|S2S3|	|1||S1|	| | | |	| | | |	| | | |
		GRank = G2G3. Global rank is for synonym *P. fernaldiana*.					
Poa pratensis L. ssp. alpigena (Fries ex Blytt) Hiitonen (13) *Poa arctica* (14)	IND.	| | |SU|	|H|E|SH|	| | | |	| | | |	| | | |	| | | |
		In the Maine checklist (Campbell et al. 1995) this taxon is included under *P. pratensis*, which is considered common in Maine.					

NAME	Div	ME	NH	VT	MA	RI	CT
Puccinellia tenella (Lange) Holmb. ssp. langeana (Berlin) Tzvelev (15)	IND.	||||	||||	||||	|||SU|	||||	||||
		GRank = G4?T3T4. Cited by one source as historic in Massachusetts, but recent manuals do not list a taxon with this name for that state. Investigation needed.					
Puccinellia tenella (Lange) Holmb. ssp. alascana (Scribn. & Merr.) Tzvelev (15) *Puccinellia langeana* ssp. *alascana* (16) [CT,MA] *Puccinellia paupercula* var. *alaskana* (11) [NH]	IND.	|?| |SU|	|||SE|	||||	|H||SH|	||||	|H|SC *|SH|
		Taxonomy and nomenclature confusing. More study needed in New England to determine status. May not be rare in Maine.					
Sorghastrum nutans (L.) Nash (14)	3*	|2| |S1|*	|||SU|	|+| |S3|	|+| |S4|	|5|C|S1|	|+| |S4|
		Disjunct in Somerset and Androscoggin Counties in Maine.					
Spartina cynosuroides (L.) Roth (14)	2	||||	||||	||||	|8|SC|S2|	|3|C|S1|	|<10| |S2|
Sphenopholis nitida (Biehler) Scribn. (14)	2	||||	||||	|1|E|S1|	|3|T|S1|	|H|SH|SH|	|H| |SH|
Sphenopholis obtusata (Michx.) Scribn. (14)	IND.	|H| |SH|	|H|E|SH|	|1|E|S1|	|||SU|	|H| |SH|	|H| |SH|
		May be more common than previously thought; more field study needed to determine status.					
Sphenopholis pensylvanica (L.) A. Hitchc. (14)	2	||||	||||	||||	|4|T|S1|	|||SU|	|H| |SH|

NAME	Div	ME	NH	VT	MA	RI	CT
Sporobolus clandestinus (Biehler) A. Hitchc. (14)	4 | | | |	| | | |	| | | |	| | | |	| | | |	| | | |	|H|SC *|SH|
Sporobolus compositus (Poir.) Merr. var. compositus (15) *Sporobolus asper* (14) [CT,ME,RI,VT]	2	|1|E|S1|	| | | |	|3|E|S1|	|3|WL|SE?|	|H|C|SH|	|5|SC|S2|
Sporobolus heterolepis A. Gray (14)	2	| | | |	| | | |	| | | |	|H| |SX|	| | | |	|5|E|S1|
Sporobolus neglectus Nash (14)	2	|H| |SH|	|1|E|S1|	|1| |S1|	|2|E|S1|	| | | |	|H|SC *|SH|
Tripsacum dactyloides L. (14)	2	| | | |	| | | |	| | | |	|1|E|S1|	|6|T|S1|	|5| |S2|
Trisetum melicoides (Michx.) Scribn. (14)	2	|2|E|S1|	|H| |SH|	|H| |SH|	| | | |	| | | |	| | | |
POLEMONIACEAE Polemonium van-bruntiae Britton (14)	1	|1|E|S1|	| | | |	|8|T|S2|	| | | |	| | | |	| | | |
GRank = G3; Fed. code = 3C.							
POLYGALACEAE Polygala senega L. (14)	2	|2|T|S1|	| | | |	|12| |S2S3|	|H| |SX|	| | | |	|2|E|S1|

NAME	Div	ME	NH	VT	MA	RI	CT
Polygala verticillata L. (11) *Polygala verticillata* var. *ambigua* (11) [CT,ME,NH,RI]	IND.	|+?||SU|	|||SU|	|?| |S2|	|+|WL|S3S4|	|2|C|S1|	|||SU|
		This taxon includes var. *ambigua* (*P. ambigua* of Gleason and Cronquist 1991) and var. *isocycla*. Most states have not differentiated between the varieties. More field study needed.					
POLYGONACEAE							
Oxyria digyna (L.) Hill (14)	2	||||	|3|T|S1|	||||	||||	||||	||||
Polygonum douglasii Greene (14)	2	|4|T|S1|	|5|T|S1|	|3|E|S1|	||||	||||	||||
Polygonum erectum L. (14)	IND.	|+?| |SU|	|H|E|SH|	|1| |S1|	|+| |S3?|	||||	|H| |SH|
		Although historically widespread, this species appears to be declining in New England. Current status unknown.					
Polygonum glaucum Nutt. (14)	1	||||	||||	||||	|~40|WL|S3|	|3|T|S1|	|H|SC *|SH|
		GRank = G3. Massachusetts has the majority of New England occurrences.					
Polygonum puritanorum Fern. (11)	IND.	|?| |SE|	||||	||||	|50|SC|S3|	| H| |SH|	||||
		GRank = G3Q. Many current treatments place this under *P. persicaria* (as do Gleason and Cronquist 1991) which is common and non-native. Treated as *Persicaria maculosa* in Maine checklist (Campbell et al. 1995) and considered non-native.					
Polygonum setaceum Baldw. var. interjectum Fern. (11) *Polygonum hydropiperoides* var. *setaceum* (14)	IND.	||||	||||	||||	|6|SC|S2|	|H|SH|SH|	||||
		Not always distinguishable from *P. hydropiperoides* according to Gleason and Cronquist (1991). More field study needed.					
Polygonum glaucum Nutt. (14)	1	||||	||||	||||	|~40|WL|S3|	|3|T|S1|	|H|SC *|SH|
		GRank = G3. Massachusetts has the majority of New England occurrences.					
Polygonum puritanorum Fern. (11)	IND.	|?| |SE|	||||	||||	|50|SC|S3|	| H| |SH|	||||
		GRank = G3Q. Many current treatments place this under *P. persicaria* (as do Gleason and Cronquist 1991) which is common and non-native. Treated as *Persicaria maculosa* in Maine checklist (Campbell et al. 1995) and considered non-native.					
Polygonum setaceum Baldw. var. interjectum Fern. (11) *Polygonum hydropiperoides* var. *setaceum* (14)	IND.	||||	||||	||||	|6|SC|S2|	|H|SH|SH|	||||
		Not always distinguishable from *P. hydropiperoides* according to Gleason and Cronquist (1991). More field study needed.					

NAME	Div	ME	NH	VT	MA	RI	CT
Polygonum tenue Michx. (14)	3*	|H| |SH|	|H|E|SH|	|1| |S1|*	|10+|WL|S2|	| |SU|	|+| |S3|
		Disjunct occurrence in Chittenden County, Vermont.					
Polygonum viviparum L. (14) *Persicaria vivipara* (1) [ME]	2	|1|E|S1|	|1|T|S1|	|H| |SH|	| | |	| | |	| | |
Rumex occidentalis S. Wats. (14) *Rumex fenestratus* (11) [MA]	4	| | |	| | |	|H| |SH|	|||SE|	| | |	| | |
		Introduced in Massachusetts, but native populations are historic in Vermont. Reported in Gleason and Cronquist (1991) from Maine, but the specimen was misidentified.					
POLYPODIACEAE							
Cheilanthes lanosa (Michx.) D. C. Eaton (12)	2	| | | |	| | | |	| | | |	| | | |	| | | |	|1|E|S1|
PONTEDERIACEAE							
Heteranthera reniformis Ruiz & Pavon (14)	4	| | | |	| | | |	| | | |	| | | |	| | | |	|H| |SH|
		Recent reports unverified and not re-located.					
Zosterella dubia (Jacq.) Small (14) *Heteranthera dubia* (11) [CT,MA,ME,NH,VT]	3*	|4|E|S1|*	|1|E|S1|	|+||S3|	|3+|WL|S2S3|	| | | |	|+||S3|
		Disjunct in Penobscot and Hancock Counties, Maine. Reported to be more common than records show in Berkshire County, Massachusetts.					

NAME	Div	ME	NH	VT	MA	RI	CT
PORTULACACEAE							
Montia fontana L. (14)	2	|12| |S2|	||||	||||	||||	||||	||||
POTAMOGETONACEAE							
Coleogeton filiformis (C.H. Persoon) Les & Haynes ssp. alpinus (M.N. Blytt) Les & Haynes (18) *Potamogeton filiformis* var. *alpinus* (1) [MA,ME,NH] *Potamogeton filiformis* var. *borealis* (14) [VT]	2	|9||S2|	|1|E|S1|	|3||S1|	|H||SX|	||||	||||
Coleogeton filiformis (C.H. Persoon) Les & Haynes ssp. occidentalis (J.W. Robbins) Les & Haynes (18) *Potamogeton filiformis* var. *occidentalis* (1) [ME]	2	|6||S2|	||||	||||	||||	||||	||||
Potamogeton confervoides Reichb. (14)	1	|14|T|S2| GRank = G3G4; Fed. code = C2.	|10+| |S2S4|	|13| |S2|	|5+| |SU|	|H| |SH|	|H|SC *|SH|
Potamogeton diversifolius Raf. (14)	IND.	|?| |SU| Status uncertain.	||||	||||	||||	||||	|H|SC *|SH|
Potamogeton hillii Morong (14)	1	|||| GRank = G3.	||||	|30| |S3|	|22|SC|S3|	||||	|1|E|S1|

NAME	Div	ME	NH	VT	MA	RI	CT
Potamogeton ogdenii Hellquist & Hilton (14)	1	||||	||||	|2| |S1|	|1| |S1|	||||	|||SU|
		GRank = G1.					
Potamogeton pusillus L. ssp. gemmiparus Robbins (14)	IND.	|10| |SU|	|6|T|S2|	||||	|19| |S3S4?|	|H| |SH|	|H|SC *|SH|
		GRank = G5T3T4. More field work needed to determine current status.					
Potamogeton strictifolius Ar. Benn. (14)	IND.	|H| |SH|	||||	|?| |SU|	|1?| |S1|	||||	|1|E|S1|
		Similar to closely related species. Questions remain on the identification of certain populations.					
Potamogeton vaseyi Robbins (14)	2	|2|E|S1|	|3|T|S2|	|6| |S2|	|1|WL|S1|	||||	|H|SC *|SH|
PRIMULACEAE							
Primula laurentiana Fern. (14)	2	|14| |S2|	||||	||||	||||	||||	||||
Primula mistassinica Michx. (14)	3*	|+| |S3|	||||	|5|T|S1|*	||||	||||	||||
		Disjunct occurrences in Caledonia and Orleans Counties, Vermont.					
PTERIDACEAE							
Cryptogramma stelleri (S. G. Gmelin) Prantl (14)	3*	|2|T|S1|*	|6|T|S1|	|+| |S3|	|5|T|S2|	||||	|2|E|S1|
		Disjunct in Somerset, Piscataquis and Oxford Counties, Maine.					
PYROLACEAE							
Pterospora andromedea Nutt. (14)	2	||||	|H| |SX|	|2|E|S1|	||||	||||	||||

NAME	Div	ME	NH	VT	MA	RI	CT
Pyrola minor L. (14)	3*	||S3?|	||SU|	|1|E|S1|*	||||	||||	||||
		Occurrences in Chittenden County, Vermont, as well as those in eastern New York state, are disjunct from the rest of this species' range.					
RANUNCULACEAE							
Anemone multifida Poiret (14)	2	|7|T|S1|	||||	|1|E|S1|	||||	||||	||||
Hydrastis canadensis L. (14)	2	||||	||||	|2|E|S1|	|2|E|S1|	||||	|2|E|S1|
Ranunculus allegheniensis Britton (14)	2	||||	||||	|8|T|S2	|1|WL|S1|	|||SU|	|7| |S2|
Ranunculus ambigens S. Wats. (14)	2	|H| |SH|	|H|E|SH|	||||	|H| |SH|	|H| |SH|	|1|E|S1|
Ranunculus gmelinii DC. var. hookeri (D. Don) L. Benson (14) *Ranunculus gmelinii* var. *purshii* (1) [ME]	2	|4|T|S1|	||||	||||	||||	||||	||||
Ranunculus hispidus Michx. (14)	IND.	||||	||||	|2| |S1|	|||SU|	||||	||||
		Future editions of FNA likely will show that var. *hispidus* and var. *caricetorum* are in New England. Gleason and Cronquist (1991) show only var. *caricetorum* here. The Maine checklist (Campbell et al. 1995) shows var. *nitidus* as existing statewide. Clarification needed.					
Ranunculus lapponicus L. (14)	2	|6|T|S1S2|	||||	||||	||||	||||	||||

NAME	Div	ME	NH	VT	MA	RI	CT
Ranunculus micranthus Nutt. (14)	2	||||	||||	||||	|4|T|S1|	|1|T|S1|	|6| |S2S3|
Trollius laxus Salisb. (14)	1	||||	||||	||||	||||	||||	|5|E|S1|
Trollius laxus ssp. *laxus* (15) [CT]		GRank = G4T3Q. GRank is for synonym *T. laxus* ssp. *laxus*.					
RHAMNACEAE							
Ceanothus herbaceus Raf. (14)	2	||||	||||	|1|E|S1	|||SE|	||||	||||
ROSACEAE							
Agrimonia parviflora Aiton (14)	2	||||	||||	||||	|3|E|S1|	||||	|6|SC|S3|
Amelanchier nantucketensis Bickn. (11)	1	|11| |S2|	||||	||||	|50|SC|S3|	||||	|||SU|
		GRank = G3Q; Fed. code = C2. Reported from Connecticut, but no specimens seen. Massachusetts has the majority of occurrences globally.					
Crataegus mollis (T. & G.) Scheele (14)	IND.	|H?| |SU|	||||	|H| |SH|	|||SU|	||||	||||
		Difficult taxonomic group. The identity of New England records for this species needs verification.					
Crataegus × silvestris Sarg. (14)	IND.	||||	||||	||||	|1|E|S1|	||||	||||
Crataegus bicknellii (31) [MA]		GRank = G1Q. GRank is for synonym *C. bicknellii*. Difficult taxonomic group; status unclear. Listed as a hybrid of *C. pruinosa* × C. *punctata* in Gleason and Cronquist (1991).					
Crataegus chrysocarpa var. *bicknellii* (11)							

NAME	Div	ME	NH	VT	MA	RI	CT
Geum peckii Pursh (14)	1	||||	|+|T|S2	||||	||||	||||	||||
		GRank = G2Q. Cronquist (Gleason and Cronquist 1991) reports this for Maine, but we have not seen specimens, nor is it in the Maine checklist (Campbell et al. 1995).					
Geum vernum (Raf.) T. & G. (14)	4	||||	||||	|H| |SH|	||||	||||	||||
Potentilla pensylvanica L. var. bipinnatifida (Douglas) T.&G. (14) *Potentilla pensylvanica* var. *pectinata* (1) [ME,VT] *Potentilla pectinata* (11) [NH]	IND.	|+||S4|	|||SU|	|1|E|S1|	||||	||||	||||
		Current status in New England is unclear. Some Vermont occurrences may be disjunct. Further field work needed.					
Potentilla robbinsiana Oakes (14)	1	||||	|2|E|S1|	||||	||||	||||	||||
		GRank = G1; Fed. code = LE.					
Prunus alleghaniensis T.C. Porter (14)	4	||||	||||	||||	|||SE|	||||	|H|SC *|SH|
		Fed. code = C2. Introduced in Massachusetts, but historic occurrences in Connecticut are thought to have been native.					
Prunus maritima Marsh. var. gravesii (Small) G. J. Anderson (15)	IND.	||||	||||	||||	||||	||||	|1|E|S1|
		GRank = G4T1Q. Correct status of this taxon is uncertain.					
Rosa acicularis Lindley ssp. sayi (Schwein.) W. H. Lewis (14) *Rosa acicularis* (14) [MA,NH,VT]	2	|H?| |SU|	|H|E|SH|	|2|E|S1|	|1|E|S1|	||||	||||

NAME	Div	ME	NH	VT	MA	RI	CT
Rosa blanda Aiton var. glabra Crépin (15) *Rosa johannensis* (14)	IND.	|?| |S2+|	||||	||||	||||	||||	||||
		GRank = G5T3Q. Present on list because of GRank, but most authors now combine this taxon under *R. blanda* which is more common. Not tracked by Maine Natural Areas Program.					
Rubus aculiferus Bailey (15) *Rubus × aculiferus* (14)	IND.	||||	|||SU|	||||	||||	||||	||||
		GRank = G2?. Listed as a putative hybrid of *R. allegheniensis* × R. *setosa* in Gleason and Cronquist (1991). Current status in New England is unknown. Appears on this list because of global rank.					
Rubus cuneifolius Pursh (14)	2	||||	|1|E|S1|	||||	|||SU|	||||	|7|SC|S2|
		Possibly adventive in New Hampshire and Massachusetts.					
Sibbaldia procumbens L. (14)`	2	||||	|1|E|S1|	||||	||||	||||	||||
Waldsteinia fragarioides (Michx.) Tratt. (14)	3*	|2|T|S1|*	|3|T|S1|	|+| |S4|	|24|SC|S3|	||||	|1|E|S1|
		Disjunct in Kennebec County, Maine.					
RUBIACEAE							
Galium kamtschaticum Steller (14)	IND.	|<3| |SU|	|2| |SU|	|?| |S2S3|	||||	||||	||||
		Distributional status in New England is unclear.					
Galium labradoricum (Wieg.) Wieg. (14)	3*	|||SU|	|H|E|S1|	|2|T|S1|*	|9+|SC|S3|*	||||	|H|SC *|SH|
		Species is disjunct in Bennington County, Vermont, and in southern Berkshire County, Massachusetts.					

NAME	Div	ME	NH	VT	MA	RI	CT
Galium trifidum L. var. trifidum (14) *Galium brevipes* (11) [ME,NH,VT]	4	|H||SU|	|||SU|	|H||SH|	||||	||||	||||
SALICACEAE							
Populus heterophylla L. (14)	2	||||	||||	||||	||||	|1|C|S1|	|4|E|S1|
Salix arctophila Cockerell (14)	2	|1|E|S1|	||||	||||	||||	||||	||||
Salix argyrocarpa Andersson (14)	2	|1|E|S1|	|5|T|S1|	||||	||||	||||	||||
Salix candida Fluegge (14)	3*	|1|T|S1|* Disjunct in Aroostook County, Maine.	||||	|+||S3|	|35|WL|S4|	||||	|15||S3|
Salix cordata Michx. (14)	IND.	|H||SH| Gleason and Cronquist's (1991) range for this species does not include Massachusetts, but it is included in Sorrie's (1991) draft county checklist for Massachusetts. This species is distinct from *S. eriocephala*. Distributional status in New England is unclear.	|1||S1|	||||	|||SU|	||||	||||
Salix exigua Nutt. ssp. interior (Rowlee) Cronquist (14) *Salix interior* (11) [ME] *Salix exigua* (15) [CT,MA,NH,VT]	3*	|2|T|S1|* Disjunct in Kennebec County, Maine.	|||SU|	|+||S3|	|10|SC|S3|	||||	|4|T|S1|
Salix herbacea L. (14)	2	|1|E|S1|	|5|T|S1S2|	||||	||||	||||	||||

NAME	Div	ME	NH	VT	MA	RI	CT
Salix myricoides (Muhl.) J. Carey (14)	2	|2| |S1|	||||	||||	||||	||||	||||
Salix planifolia Pursh (14)	2	|1|E|S1|	|4|T|S2|	|1|T|S1|	||||	||||	||||
Salix uva-ursi Pursh (14)	2	|2|T|S1|	|10+| |S2S3|	|2|E|S1|	||||	||||	||||
SANTALACEAE							
Geocaulon lividum (Richardson) Fern. (14)	2	|10| |S2|	|4|T|S2|	|H| |SX|	||||	||||	||||
SAURURACEAE							
Saururus cernuus L. (14)	2	||||	||||	||||	|H| |SX|	|1|E|S1|	|3|E|S1|
SAXIFRAGACEAE							
Saxifraga aizoides L. (14)	2	||||	||||	|2| |S1|	||||	||||	||||
Saxifraga cernua L. (14)	2	||||	|1|E|S1|	||||	||||	||||	||||
Saxifraga foliolosa R. Br. (14) *Saxifraga stellaris* var. *comosa* (11)	2	|1|E|S1|	||||	||||	||||	||||	||||
Saxifraga oppositifolia L. (14)	2	||||	||||	|5| |S1|	||||	||||	||||

NAME	Div	ME	NH	VT	MA	RI	CT
Saxifraga paniculata Mill. (15) *Saxifraga aizoon* var. *neogaea* (11) [NH,VT]	2	|2|T|S1|	|2|E|S1|	|5||S1|	||||	||||	||||
Saxifraga rivularis L. (14)	2	||||	|3|E|S1|	||||	||||	||||	||||
SCROPHULARIACEAE							
Agalinis acuta Pennell (14)	1	|||| GRank = G1; Fed. code = LE.	||||	||||	|3|E|S1|	|1|E|S1|	|1|E|S1|
Agalinis neoscotica Greene (11) *Agalinis purpurea* var. *neoscotica* (14)	1	|4|E|S1| GRank = G2?.	||||	||||	||||	||||	||||
Aureolaria virginica (L.) Pennell (14)	3*	|||| Occurrence in Franklin County, Vermont, is disjunct.	|4|T|S2|	|2| |S1|*	|+| |S4?|	|12| |S2|	|+| |S3|
Castilleja coccinea (L.) Sprengel (14)	2	|H| |SX|	|H| |SX|	||||	|H| |SX|	|H|SH|SH|	|4|E|S1|
Castilleja septentrionalis Lindl. (14)	2(a)	|25| |S3| Small numbers of plants at most occurrences are cause for concern.	|2|T|S1|	|1|T|S1|	||||	||||	||||
Collinsia parviflora Dougl. (14)	4	|||| Native occurrences are historic. Introduced occurrence in Massachusetts is also not extant.	||||	|H| |SH|	|||SE|	||||	||||

NAME	Div	ME	NH	VT	MA	RI	CT
Euphrasia disjuncta Fern. & Wieg. (14)	4	|H| |SX|	| | | |	| | | |	| | | |	| | | |	| | | |
Euphrasia oakesii Wettst. (14)	2	|1|E|S1|	|1|E|S1|	| | | |	| | | |	| | | |	| | | |
Gratiola virginiana L. (14)	2	| | | |	| | | |	| | | |	| | | |	|2|C|S1|	| | | |
Melampyrum lineare Desr. var. latifolium Barton (14)	IND.	| | |SU|	|H| |SH|	| | | |	| | |SU|	| | | |	|?| |SU|
		Most specimens not identified to the varietal level. Field work and specimen annotation needed.					
Melampyrum lineare Desr. var. lineare (14)	IND.	| | |SU|	| | |SU|	| | |SU|	| | | |	| | | |	| | | |
		Most specimens not identified to the varietal level. Field work and specimen annotation needed.					
Melampyrum lineare Desr. var. pectinata (Pennell) Fern. (14)	IND.	| | | |	| | |SU|	| | | |	| | |SU|	| | |SU|	| | |SU|
		Most specimens not identified to the varietal level. Field work and specimen annotation needed.					
Mimulus alatus Aiton (14)	2	| | | |	| | | |	| | | |	|3|E|S1|	| | | |	|1| |S1|
Mimulus moschatus Douglas (14)	2	| | |SE|	|3|E|S1|	|6| |S2|	|4|T|S1|	| | | |	|H| |SH|
		This species is introduced into some New England states; determining which occurrences are native is often difficult.					
Mimulus ringens L. var. colpophilus Fern. (11)	IND.	|12| |S2|	| | | |	| | | |	| | | |	| | | |	| | | |
		GRank = G5T2Q; Fed. code = C2. Taxonomic status unclear.					

NAME	Div	ME	NH	VT	MA	RI	CT
Pedicularis furbishiae S. Wats. (14)	1	|26|E|S2|	||||	||||	||||	||||	||||
		GRank = G2; Fed. code = LE.					
Pedicularis lanceolata Michx. (14)	2	||||	||||	||||	|2|E|S1|	||||	|3| |S1|
Rhinanthus crista-galli L. (14) *Rhinanthus minor* (15) [MA]	IND.	|?| |SU|	|1| |S3|	|||SU|	|||SE|	||||	|||SE|
		Difficult to determine which occurrences are native and which are introduced. Gleason and Cronquist (1991) state that our lowland plants are introduced and the alpine plants are native.					
Schwalbea americana L. (14)	4	||||	||||	||||	|H| |SX|	||||	|H|SC *|SH|
		GRank = G2; Fed. code = LE. In New England, this species was last seen in Massachusetts in 1963.					
Veronica catenata Pennell (14) *Veronica anagallis-aquatica* (1) [ME]	IND.	|||SE|	||||	|1| |S1|	|2|E|S1|	||||	||||
		Difficult to determine which occurrences are native and which are introduced. Gleason and Cronquist (1991) state that *V. catenata* hybridizes with *V. anagallis-aquatica* and is included in the latter taxon by some authors.					
Veronica wormskjoldii Roemer & Schultes (14)	2	|1|E|S1|	|2|E|S1|	||||	||||	||||	||||
Veronicastrum virginicum (L.) Farw. (14)	IND.	|||SE|	||||	|1|E|S1|	|10|SC|S2|	||||	|9| |SU|
		Difficult to determine which occurrences are native and which are introduced.					

NAME	Div	ME	NH	VT	MA	RI	CT
SELAGINELLACEAE							
Selaginella eclipes W. R. Buck (12)	IND.	||||	||||	||||	||||	||||	|2| |SU|
		Species is not included in New England in FNA (Flora of North America Editorial Committee 1993), but a specimen from Connecticut was later annotated as this species.					
SMILACACEAE							
Smilax tamnoides L. (15) *Smilax tamnoides* var. *hispida* (11) [CT] *Smilax hispida* (14)	4	||||	||||	||||	||||	||||	|H|SC *|SH|
SOLANACEAE							
Leucophysalis grandiflora (Hook.) Rydb. (14) *Physalis grandiflora* (15) [VT]	4	||||	||||	|H||SH|	||||	||||	||||
		GRank = G3G4.					
Physalis longifolia Nutt. var. subglabrata (Mackenzie & Bush) Cronquist (14) *Physalis subglabrata* (11) [CT,NH,RI,VT]	IND.	|||SE|	|||SU|	|H||SH|	|||SE|	|H||SH|	|H||SH|
		More field work needed to determine status. Difficult to determine which populations are native.					

NAME	Div	ME	NH	VT	MA	RI	CT
SPARGANIACEAE							
Sparganium minimum (Hartm.) Fries (14) *Sparganium natans* (15) [MA]	3*	|?| |SU|	| |SU|	|13|T|S2|	|4|T|S1|*	| | | |	|H|SC *|SH|
		Disjunct in Berkshire County, Massachusetts.					
ULMACEAE							
Ulmus thomasi Sarg. (14)	4	| | | |	| | | |	|H| |SH|	| | | |	| | | |	| | | |
		Extant populations in Vermont are introduced. Native populations are historic.					
URTICACEAE							
Pilea fontana (Lunell) Rydb. (14)	IND.	| | | |	| | | |	| | | |	|?| |S3?|	| | | |	|4| |SU|
		More field study needed. Species has been overlooked in New England because of similarity with *P. pumila*.					
VALERIANACEAE							
Valeriana uliginosa (T. & G.) Rydb. (14)	2	|10| |S2|	|1|E|S1|	|1|E|S1|	| | | |	| | | |	| | | |
Valerianella radiata (L.) Dufr. (14) *Valerianella radiata* var. *fernaldiana* (11) [CT]	4	| | | |	| | | |	| | | |	| | | |	| | | |	|H|SC *|SH|

NAME	Div	ME	NH	VT	MA	RI	CT
VERBENACEAE							
Verbena simplex Lehm. (14)	2	||||	||||	|H| |SH|	|1|E|S1|	||||	|H| |SH|
VIOLACEAE							
Hybanthus concolor (T. Forster) Sprengel (14)	2	||||	||||	|1| |S1|	||||	||||	|H|SC *|SH|
Viola brittoniana Pollard (11) *Viola pedatifida* ssp. *brittoniana* (13)	2	|H| |SH|	||||	||||	|6|T|S1|	||||	|2|E|S1|
		Preliminary research indicates that one Massachusetts population of this taxon is known as *V. brittoniana* var. *pectinata* (GRank of G4G5T3Q as *V. brittoniana* ssp. *pectinata*). It is genetically distinct from the other Massachusetts occurrences.					
Viola hirsutula Brainerd (11)	4	||||	||||	||||	||||	||||	|H|SC *|SH|
Viola novae-angliae House (11)	2	|15| |S2|	||||	||||	||||	||||	||||
		Fed. code = 3C.					
Viola palmata L. (22) *Viola triloba* var. *dilatata* (11) [MA]	IND.	||||	||||	||SU|	||SU|	||SU|	||SU|
		The taxonomic relationship within this complex is very uncertain. The nomenclature reflects this confusion. Further study needed.					
Viola palustris L. (14)	2	|1|E|S1|	|4|T|S2|	||||	||||	||||	||||
Viola striata Aiton (14)	IND.	||SE|	||SU|	||||	||SE|	||||	|H|SC *|SH|
		More field study needed to determine status. New England occurrences should be suspect since this species is cultivated and sometimes escapes.					

NAME	Div	ME	NH	VT	MA	RI	CT
Viola subsinuata Greene (22)	IND.	||||	||||	|||SU|	|||SU|	||||	|||SU|

The nomenclature of this taxon in New England (which may involve *V. palmata* and its varieties as synonyms) is hopelessly confusing. Clarification is desperately needed.

XYRIDACEAE

Xyris smalliana Nash (14)	3*	|1|E|S1|*	||||	||||	|+| |SU|	|+| |S2|	|4|E|S1|

Since the Essex County, Massachusetts, occurrences are dated pre-1970, the York County, Maine, occurrence is considered to be disjunct.

ACKNOWLEDGMENTS. The production of a list of this magnitude involves many people. First and foremost, we thank the NEPCoP Listing Committee members for their time, information, support, and patience. This Committee met regularly for almost four years to assure the accuracy and reliability of the List.

Primary support for "*Flora Conservanda:* New England" has been provided by the National Fish and Wildlife Foundation and the Ellis L. Phillips Foundation. Additionally, we thank the Andrew W. Mellon Foundation, the Jessie B. Cox Charitable Trust, and the Surdna Foundation for their support of NEPCoP.

Staff of the Maine Natural Areas Program, the New Hampshire Natural Heritage Inventory Program, the Vermont Nongame and Natural Heritage Program, the Massachusetts Natural Heritage and Endangered Species Program, the Rhode Island Natural Heritage Program, and the Connecticut Natural Diversity Data Base have supported this effort by supplying information that is the basis for this List. Leslie Sneddon and Steve Buttrick of The Nature Conservancy's Eastern Regional Office, as well as Larry Morse and Kelly Watson of the International Headquarters of TNC, have generously supplied GRanks and other information for taxa included on this List.

Many botanists have contributed time and advice, especially on nomenclatural matters: Susan G. Aiken, Kelly W. Allred, Loran C. Anderson, George W. Argus, Peter W. Ball, Harvey E. Ballard, Fred R. Barrie, David E. Boufford, Christopher S. Campbell, Judith M. Canne-Hilliker, J. Richard Carter, Paul M. Catling, Ross C. Clark, Steven E. Clemants, Garrett E. Crow, Thomas F. Daniel, Brian E. Dutton, Michael Donoghue, Patrick E. Elvander, Barbara Ertter, John E. Fairey, Wayne R. Ferren, Robert W. Freckmann, Shirley A. Graham, Craig C. Greene, Erich Haber, David W. Hall, Jon Hamer, Ronald L. Hartman, Steven L. Hatch, Robert R. Haynes, Harold R. Hinds, Peter C. Hoch, Walter C. Holmes, Rick Kesseli, Robert Kral, Sylvia Kelso, Eric Lamont, David E. Lemke, Donald H. Les, Walter H. Lewis, Niall McCarter, Landon E. McKinney, John McNeill, Richard S. Mitchell, David Moore, Michael O. Moore, John K. Morton, Robert F. C. Naczi, John B. Nelson, Ching-I Peng, C. Thomas Philbrick, James B. Phipps, Robert A. Price, James S. Pringle, Anton A. Reznicek, Velva E. Rudd, David Schroeder, Alfred E. Schuyler, Fayla Schwartz, John C. Semple, Charles J. Sheviak, Teresa Sholars, Leila M. Shultz, Neil Snow, Robert J. Soreng, Janet R. Sul-

livan, W. Carl Taylor, Edward E. Terrell, John Thieret, David M. Thompson, Rahmona A. Thompson, Gordon C. Tucker, Florence S. Wagner, Warren H. Wagner, Warren L. Wagner, Donna M. E. Ware, and Alan S. Weakley. The authors apologize to anyone who offered advice but was inadvertently omitted from the Acknowledgments.

Steve Young of the New York Heritage Program helped greatly by providing location data from that state. Guy Jolicoeur of Le Centre de Donnees sur le Patrimonie Naturel du Quebec provided location data from the Province of Quebec.

Judy Unger of the Flora of North America Project office at the Missouri Botanical Garden patiently supplied names and telephone numbers of many authors of treatments for future FNA volumes.

Judy Warnement and other staff of the Harvard University Herbaria helped in finding many of the publications necessary for clarification of nomenclatural and taxonomic issues.

Mike O'Neal of BG-Base is thanked for his patience and good humor during the many hours spent improving the database format.

Additional support for the production of this List has been given by the State Geological and Natural History Survey of Connecticut, the New England Wild Flower Society, and the Department of Ecology and Evolutionary Biology, University of Connecticut. Gregory J. Anderson and Ellie DeCarli of the University of Connecticut, as well as Richard Hyde of the Connecticut Department of Environmental Protection, are thanked for their patience and support.

Kelly Slater of NEWFS is thanked for her tireless recording of our meetings, and for keeping the Conservation Director in line. Barbara Pryor, Sarah Schonbrun and David DeKing of NEWFS are thanked for their assistance and encouragement. George McCully is thanked for his support for NEPCoP and for devising the title for the NEPCoP List.

We gratefully acknowledge Susi von Oettingen of the U.S. Fish and Wildlife Service office in Concord, New Hampshire, for allowing us to use the facilities at her office for many meetings. The Concord, New Hampshire, D'Angelo's delivery service personnel who did not steal our pens are thanked; those who did are thanked for the humor they supplied during sometimes tedious meetings.

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APPENDIX I. STATE STATUS CODES.

Connecticut: (Connecticut Department of Environmental Protection 1993). Public Act 89-224.

E = Endangered—any native species documented by biological research and inventory to be in danger of extirpation throughout all or a significant portion of its range within Connecticut and to have no more than *five* occurrences in the state, and any species determined to be an "endangered species" pursuant to the federal Endangered Species Act.

T = Threatened—any native species documented by biological research and inventory to be likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range within Connecticut and to have no more than *nine* occurrences in the state, and any species determined to be a "threatened species" pursuant to the federal Endangered Species Act, except for such species determined to be endangered by the Commissioner in accordance with section 4 of Public Act 89-224.

SC = Special Concern—any native plant species or any native nonharvested wildlife species documented by scientific research and inventory to have a naturally restricted range or habitat in the state, to be at a low population level, to be in such high demand by man that its unregulated taking would be detrimental to the conservation of its population.

SC * = extirpated from the state.

Maine: Maine Revised Statutes Annotated 5 MSRA C. 383, sub C. III, articles 1-A.

E = Endangered—any native plant that is in danger of extinction throughout all or a significant portion of its range within the State or any species determined to be an endangered species pursuant to the United States Endangered Species Act of 1973, Public Law 93-205, as amended.

T = Threatened—any species of native plant likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range or any species of plant determined to be a threatened species pursuant to the federal Endangered Species Act of 1973 as amended.

Massachusetts: (State of Massachusetts 1992). Massachusetts Endangered Species Act, MGL c. 131A and its regulations, 321 CMR 10.00.

E = Endangered—any species of plant or animal in danger of extinction throughout all or a significant portion of its range and species of plants or animals in danger of extirpation as documented by biological research and inventory.

T = Threatened—any species of plant or animal likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range and any species declining or rare as determined by biological research and inventory and likely to become endangered in the foreseeable future.

SC = Special Concern—any species of plant or animal which has been documented by biological research and inventory to have suffered a decline that could threaten the species if allowed to continue unchecked or that occurs in such small numbers or with such a restricted distribution or specialized habitat requirements that it could easily become threatened within Massachusetts.

WL = Watch List—species with no legal standing, but considered by the state botanist to be sufficiently uncommon to be monitored in the field and studied further for possible listing (or relisting in some cases) under the Massachusetts ESA regulations.

New Hampshire: (New Hampshire Natural Heritage Inventory 1995). State law RSA 217-A:3, III, passed in 1987.

E = Endangered (Note: this state code is actually SE, State Endangered. It has been changed to E in this list for consistency.)—all species in New Hampshire determined to be endangered as defined by RSA 217-A:3, III, or native plants documented as having *three* or fewer occurrences in the state within the last 50 years, or plants with more than three occurrences which are, in the judgment of specialists, especially vulnerable to extirpation.

T = Threatened (Note: this state code is actually ST, State Threatened. It has been changed to T in this list for consistency.)—all species occurring in New Hampshire determined to be a threatened species as defined by RSA 217-A:3, XII or Federal candidate species as defined by Res-N 306.01 occurring in New Hampshire which are not listed on the endangered species listing as contained in Res-N 306.02 or native plants documented as having *ten* or fewer natural occurrences within the last 20 years or are otherwise threatened by extirpation due to habitat loss or other factors.

SC = Special Concern—plant species not threatened or endangered, but listed under state law as Special Concern Plant Species because they may be subject to commercial exploitation or overcollecting.

Rhode Island: (Enser 1996). Rhode Island State Endangered Species Act, Title 20, Chapter 37-1 of the General Laws of the State of Rhode Island.

E = Endangered (Note: this state code is actually SE, State Endangered. It has been changed to E in this list for consistency. Federally Endangered taxa, given the code FE, and Federally Threatened taxa, given the code FT by Rhode Island, are also changed to E in this list.)—in addition to the preceding federally ranked taxa, native taxa in imminent danger of extirpation from Rhode Island. These taxa may meet one or more of the following criteria: taxa formerly considered by the U.S. Fish and Wildlife Service for listing as Federally endangered or threatened (former C2 category species); a taxon with *one or two* known or estimated total populations in the state; a taxon apparently globally rare or threatened, estimated to occur at approximately 100 or fewer sites range-wide.

T = Threatened (Note: this state code is actually ST, State Threatened. It

has been changed to T in this list for consistency.)—native taxa which are likely to become State Endangered in the future if current trends in habitat loss or other detrimental factors remain unchanged. In general these taxa have *three to five* known or estimated populations and are especially vulnerable to habitat loss.

C = Concern—native taxa which do not qualify under other categories but are additionally listed due to various factors of rarity and/or vulnerability.

SH State Historical—native taxa which have been documented for Rhode Island during the last 150 years but for which there are no extant populations.

Vermont: State status as per the Vermont Endangered Species Law 10 V.S.A. Chapter 123 passed in 1991.

E = Endangered. An endangered species means any species whose continued existence as a viable component of the state's wild flora or fauna is determined to be in jeopardy. The term shall also include any species of wildlife or plant determined to be an endangered species pursuant to the Federal Endangered Species Act.

T = Threatened. A threatened species means any species of wild flora or fauna which appears likely within the foreseeable future to become endangered. That term shall also include any species of wildlife or plant determined to be a threatened species pursuant to the Federal Endangered Species Act.

APPENDIX II. GLOBAL RANKS (GRanks; adapted from The Nature Conservancy 1996 and Master 1991).

Ranks issued by the Nature Conservancy's Biological Conservation Database. A species is given a Global Rank of G followed by a number or symbol, and a variety or subspecies has a T followed by a number or symbol. (For example, for *Eupatorium leucolepis* var. *novae-angliae,* the Global Rank G5T1 means that the species is secure globally, G5, but that the variety is critically imperiled globally, T1.)

G1 = Critically imperiled globally because of extreme rarity or because of some factor(s) making it especially vulnerable to extinction (typically 5 or fewer occurrences or very few remaining individuals or acres).

G2 = Imperiled globally because of rarity or because of some factor(s) making it very vulnerable to extinction throughout its range (typically 6 to 20 occurrences or few remaining individuals or acres).

G3 = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single state or a physiographic region in the East) or because of other factors making it vulnerable to extinction throughout its range (typically 21 to 100 occurrences).

G4 = Widespread, abundant, and apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery. Thus, the taxon is of long-term concern (usually 100 or more occurrences).

G5 = Demonstrably widespread, abundant, and secure globally, though it may be quite rare in parts of its range, especially at the periphery.

G#G# = Numeric range rank: A range spanning two or more of the nu-

meric ranks. Denotes range of uncertainty about the exact rarity (for example—G2G3).

G? = Unranked, Element is not yet ranked globally.

G#T# = For infraspecific taxa: The GRank applies to the full species and the TRank applies to the infraspecific taxon.

Subrank

T = Taxonomic subdivision: rank applies to a subspecies or variety.

T#T# = Numeric range rank: A range spanning two or more of the numeric ranks for a variety or subspecies. Denotes range of uncertainty about the exact rarity of variety or subspecies (for example—G5T2T3).

Qualifiers

? = Inexact or uncertain. (For example, G3? or G5T3? means that the numeric ranking is uncertain.)

Q = Questionable taxonomy: taxonomic status is questionable; numeric rank may change with taxonomy. (For example, G4T3Q means that the taxonomy, in this case of the subspecies or variety, is questionable.)

APPENDIX III. STATE RANKS (SRanks; adapted from The Nature Conservancy 1996 and Master 1991).

S1 = Critically imperiled in the state because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation from the state (typically 5 or fewer occurrences or very few remaining individuals).

S2 = Imperiled in the state because of rarity or because of some factor(s) making it very vulnerable to extirpation from the state (typically 6 to 20 occurrences or few remaining individuals).

S3 = Rare and uncommon in the state (typically 21 to 100 occurrences).

S4 = Widespread, abundant, and apparently secure in state, with many occurrences, but is of long-term concern (usually 100 or more occurrences).

S5 = Demonstrably widespread, abundant, and secure in the state, and essentially ineradicable under present conditions.

S#S# = Numeric range rank: A range spanning two or more of the numeric ranks. Denotes range of uncertainty about the exact rarity (for example—S2S3).

S? = Unranked: not yet ranked in the state.

SU = Unrankable: status uncertain; more information needed.

SE = Exotic: an exotic species established in the state.

SR = Reported in the state but without persuasive documentation to provide a basis for either accepting or rejecting (e.g., misidentified specimen) the report. Some of these are very recent discoveries for which first-hand information has yet to be received; others are old, obscure reports that are hard to dismiss because the habitat is now destroyed.

SH = Historical: occurred historically in the state.

SX = Extirpated: believed to be extirpated from the state.

Qualifier

? = Inexact or uncertain.

APPENDIX IV. FEDERAL LISTING DESIGNATIONS.

Codes used by the U.S. Fish and Wildlife Service (USFWS) for plants in this list under the U.S. Endangered Species Act of 1973 (the Act) as amended.

Listed Species

LE = Listed Endangered (Note: this Federal code is actually E, Endangered. It has been changed to LE in this list to distinguish from state endangerment status.) - taxa that are in danger of extinction throughout all or a significant portion of their range in the U.S.

LT = Listed Threatened (Note: this Federal code is actually T, Threatened. It has been changed to LT in this list to distinguish from state threatened status.) - taxa that may become endangered in the foreseeable future throughout all or a significant portion of their range in the U.S.

Former Candidate Species

The U.S. Fish and Wildlife Service is required to identify species of wildlife and plants that are endangered or threatened based on the best available scientific and commercial information. As part of the program to identify species for possible listing, the USFWS has maintained a list of species regarded as candidates for listing. Prior to 1996, there were 18 plant taxa occurring in New England that were considered candidates for listing. These taxa, known as Category 2 taxa, were considered taxa for which some information indicated that they might be in danger, but insufficient data on biological vulnerability and threat were available to support listing.

In February 1996, the USFWS published a Proposed Rule which changed the definition of Candidate species, and narrowed the Candidate list to 182 taxa of plants and animals nationally. No plant taxa in New England now appear on this new Candidate list which was given a Notice of final decision on December 5, 1996 (U.S. Fish and Wildlife Service 1996). The Former Candidate species, designated here as 'C2,' technically are no longer monitored (tracked) by the USFWS, but are included in "*Flora Conservanda:* New England" where appropriate in order that their status can be followed.

C2 = Former Candidate species.

Taxa no longer under Consideration by the USFWS

Taxa that were once considered for listing as endangered but are no longer under such consideration were historically included in Category 3. Such taxa were subdivided further into three subcategories to indicate the reason for their removal from consideration. This designation of Category 3 has been discontinued under the Final Rule published in 1996 (U.S. Fish and Wildlife Service 1996).

3A = Taxa for which the USFWS has persuasive evidence of extinction. If rediscovered, such taxa might acquire high priority for listing. At this time, however, the best available information indicates that the taxa in this subcategory, or the habitats from which they were known, have been lost.

3B = Names that, on the basis of current taxonomic understanding (usually as represented in published revisions and monographs), do not represent distinct taxa meeting the Act's definition of "species." Such supposed taxa could be reevaluated in the future on the basis of new information.

3C = Taxa that have proven more abundant or widespread than previously

believed as well as taxa that are not subject to any identifiable threat. If further research or changes in habitat indicate a significant decline in these taxa, they may be reevaluated for possible inclusion as candidates.

INDEX TO THE NEPCOP LIST

NAME	FAMILY	NEPCoP DIVISION
Achillea borealis	ASTERACEAE	IND.
Achillea millefolium var. *borealis* —see Achillea borealis		
Achillea millefolium var. *nigrescens* —see Achillea borealis		
Adiantum aleuticum	ADIANTACEAE	2
Adiantum viridimontanum	ADIANTACEAE	1
Agalinis acuta	SCROPHULARIACEAE	1
Agalinis neoscotica	SCROPHULARIACEAE	1
Agalinis purpurea var. *neoscotica* —see Agalinis neoscotica		
Agastache nepetoides	LAMIACEAE	2
Agastache scrophulariifolia	LAMIACEAE	2
Agrimonia parviflora	ROSACEAE	2
Agrostis borealis —see Agrostis mertensii		
Agrostis mertensii	POACEAE	2
Amaranthus pumilus	AMARANTHACEAE	4
Amaranthus tuberculatus	AMARANTHACEAE	2
Amelanchier nantucketensis	ROSACEAE	1
Amerorchis rotundifolia	ORCHIDACEAE	2
Ammophila champlainensis	POACEAE	IND.
Amphicarpum purshii	POACEAE	2
Anemone multifida	RANUNCULACEAE	2
Angelica lucida	APIACEAE	IND.
Angelica venenosa	APIACEAE	4
Aplectrum hyemale	ORCHIDACEAE	2
Arabis drummondii	BRASSICACEAE	3:VT
Arabis laevigata	BRASSICACEAE	3:ME
Arabis missouriensis	BRASSICACEAE	IND.
Arctostaphylos alpina	ERICACEAE	2
Arenaria caroliniana	CARYOPHYLLACEAE	4
Arenaria glabra —see Minuartia glabra		
Arenaria groenlandica var. *glabra* —see Minuartia glabra		
Arenaria groenlandica var. *groenlandica* —see Minuartia groenlandica		
Arenaria macrophylla —see Moehringia macrophylla		
Arenaria marcescens —see Minuartia marcescens		
Arenaria rubella —see Minuartia rubella		

NAME	FAMILY	NEPCoP DIVISION
Arethusa bulbosa	ORCHIDACEAE	3:CT,MA, RI,VT
Aristida basiramea	POACEAE	IND.
Aristida purpurascens	POACEAE	2
Aristida tuberculosa	POACEAE	2
Aristolochia serpentaria	ARISTOLOCHIACEAE	2
Armoracia lacustris —see Neobeckia aquatica		
Arnica lanceolata	ASTERACEAE	1
Arnica mollis —see Arnica lanceolata		
Artemisia campestris ssp. borealis	ASTERACEAE	2
Artemisia campestris var. *canadensis* —see Artemisia campestris ssp. borealis		
Artemisia campestris ssp. caudata	ASTERACEAE	3:VT
Asclepias purpurascens	ASCLEPIADACEAE	2
Asclepias tuberosa	ASCLEPIADACEAE	3:MA
Asclepias variegata	ASCLEPIADACEAE	2
Asclepias viridiflora	ASCLEPIADACEAE	4
Asplenium montanum	ASPLENIACEAE	2
Asplenium trichomanes-ramosum	ASPLENIACEAE	2
Asplenium viride —see Asplenium trichomanes-ramosum		
Aster anticostensis	ASTERACEAE	4
Aster concolor	ASTERACEAE	2
Aster dumosus	ASTERACEAE	3:ME
Aster infirmus	ASTERACEAE	2
Aster praealtus	ASTERACEAE	IND.
Aster prenanthoides	ASTERACEAE	2
Aster ptarmicoides —see Solidago ptarmicoides		
Aster sagittifolius	ASTERACEAE	2
Astragalus alpinus var. brunetianus	FABACEAE	1
Astragalus canadensis	FABACEAE	2
Astragalus eucosmus	FABACEAE	4
Astragalus robbinsii var. jesupii	FABACEAE	1
Astragalus robbinsii var. minor	FABACEAE	2
Astragalus robbinsii var. robbinsii	FABACEAE	4
Aureolaria virginica	SCROPHULARIACEAE	3:VT
Barbarea orthoceras	BRASSICACEAE	2

NAME	FAMILY	NEPCoP DIVISION
Betula borealis —see Betula minor		
Betula glandulosa	BETULACEAE	2
Betula minor	BETULACEAE	1
Betula × *minor* —see Betula minor		
Betula nana —see Betula glandulosa		
Betula nigra	BETULACEAE	2
Betula pumila	BETULACEAE	3:NH
Bidens eatonii	ASTERACEAE	1
Bidens heterodoxa	ASTERACEAE	IND.
Bidens hyperborea	ASTERACEAE	2
Bidens hyperborea var. *cathancensis* —see Bidens hyperborea var. svensonii		
Bidens hyperborea var. *colpophila* —see Bidens hyperborea		
Bidens hyperborea var. svensonii	ASTERACEAE	IND.
Blephilia ciliata	LAMIACEAE	2
Blephilia hirsuta	LAMIACEAE	2
Blephilia hirsuta var. glabrata	LAMIACEAE	IND.
Bolboschoenus maritimus	CYPERACEAE	3:VT
Bolboschoenus novae-angliae	CYPERACEAE	2
Botrychium lunaria	OPHIOGLOSSACEAE	2
Botrychium minganense	OPHIOGLOSSACEAE	IND.
Botrychium oneidense	OPHIOGLOSSACEAE	IND.
Botrychium rugulosum	OPHIOGLOSSACEAE	IND.
Bouteloua curtipendula	POACEAE	2
Braya humilis	BRASSICACEAE	2
Cacalia suaveolens	ASTERACEAE	4
Calamagrostis canadensis var. langsdorfii	POACEAE	4
Calamagrostis lacustris —see Calamagrostis stricta ssp. inexpansa		
Calamagrostis neglecta —see Calamagrostis stricta ssp. stricta		
Calamagrostis nubila —see Calamagrostis canadensis var. langsdorfii		
Calamagrostis pickeringii	POACEAE	2
Calamagrostis stricta ssp. inexpansa	POACEAE	2
Calamagrostis stricta var. *inexpansa* —see Calamagrostis stricta ssp. inexpansa		
Calamagrostis stricta ssp. stricta	POACEAE	2

NAME	FAMILY	NEPCoP DIVISION
Callitriche hermaphroditica	CALLITRICHACEAE	4
Callitriche terrestris	CALLITRICHACEAE	4
Calypso bulbosa	ORCHIDACEAE	3:VT
Calystegia spithamaea	CONVOLVULACEAE	2
Cardamine bellidifolia	BRASSICACEAE	2
Cardamine concatenata	BRASSICACEAE	3:ME
Cardamine douglassii	BRASSICACEAE	2
Cardamine × incisa	BRASSICACEAE	IND.
Cardamine longii	BRASSICACEAE	1
Cardamine maxima —see Cardamine × maxima		
Cardamine × maxima	BRASSICACEAE	IND.
Cardamine pratensis var. palustris	BRASSICACEAE	2
Carex adusta	CYPERACEAE	2
Carex albicans var. emmonsii	CYPERACEAE	3:VT
Carex alopecoidea	CYPERACEAE	2
Carex arcta	CYPERACEAE	3:VT
Carex atherodes	CYPERACEAE	4
Carex atratiformis	CYPERACEAE	2
Carex backii	CYPERACEAE	3:ME
Carex baileyi	CYPERACEAE	3:ME
Carex barrattii	CYPERACEAE	2
Carex bicknellii	CYPERACEAE	IND.
Carex bigelowii	CYPERACEAE	3:VT
Carex bushii	CYPERACEAE	2
Carex buxbaumii	CYPERACEAE	3:VT
Carex capillaris	CYPERACEAE	2
Carex capillaris ssp. *capillaris* —see Carex capillaris		
Carex capitata	CYPERACEAE	2
Carex capitata ssp. *arctogena* —see Carex capitata		
Carex chordorrhiza	CYPERACEAE	3:MA,VT
Carex collinsii	CYPERACEAE	2
Carex crawei	CYPERACEAE	2
Carex davisii	CYPERACEAE	2
Carex dioica var. *gynocrates* —see Carex gynocrates		
Carex eburnea	CYPERACEAE	3:ME
Carex emmonsii —see Carex albicans var. emmonsii		
Carex flaccosperma var. *glaucodea* —see Carex glaucodea		
Carex foenea —see Carex siccata		

NAME	FAMILY	NEPCoP DIVISION
Carex garberi	CYPERACEAE	1
Carex garberi var. *bifaria* —see Carex garberi		
Carex glaucodea	CYPERACEAE	2
Carex gracilescens	CYPERACEAE	2
Carex gynocrates	CYPERACEAE	IND.
Carex livida	CYPERACEAE	2
Carex livida var. *radicaulis* —see Carex livida		
Carex lupuliformis	CYPERACEAE	1
Carex mitchelliana	CYPERACEAE	1
Carex muhlenbergii	CYPERACEAE	3:VT
Carex nigromarginata	CYPERACEAE	4
Carex norvegica	CYPERACEAE	2
Carex oligocarpa	CYPERACEAE	2
Carex oronensis	CYPERACEAE	1
Carex polymorpha	CYPERACEAE	1
Carex prairea	CYPERACEAE	3:ME
Carex praticola	CYPERACEAE	4
Carex rariflora	CYPERACEAE	4
Carex recta	CYPERACEAE	IND.
Carex richardsonii	CYPERACEAE	2
Carex saxatilis	CYPERACEAE	2
Carex schweinitzii	CYPERACEAE	1
Carex scirpoidea	CYPERACEAE	2
Carex siccata	CYPERACEAE	3:VT
Carex sparganioides	CYPERACEAE	3:ME
Carex sterilis	CYPERACEAE	2
Carex striata var. brevis	CYPERACEAE	2
Carex striatula	CYPERACEAE	2
Carex tenuiflora	CYPERACEAE	2
Carex tetanica	CYPERACEAE	2(a)
Carex trichocarpa	CYPERACEAE	2
Carex vaginata	CYPERACEAE	2
Carex wiegandii	CYPERACEAE	1
Carex willdenowii	CYPERACEAE	4
Carex woodii	CYPERACEAE	4
Cassia hebecarpa —see Senna hebecarpa		
Cassiope hypnoides —see Harrimanella hypnoides		
Castilleja coccinea	SCROPHULARIACEAE	2
Castilleja septentrionalis	SCROPHULARIACEAE	2(a)
Ceanothus herbaceus	RHAMNACEAE	2
Cerastium nutans	CARYOPHYLLACEAE	2
Ceratophyllum echinatum	CERATOPHYLLACEAE	3:ME

NAME	FAMILY	NEPCoP DIVISION
Cercis canadensis	CAESALPINIACEAE	4
Chamaelirium luteum	LILIACEAE	2
Chamaesyce glyptosperma —see Euphorbia glyptosperma		
Cheilanthes lanosa	POLYPODIACEAE	2
Chenopodium berlanderi var. *boscianum* —see Chenopodium standleyanum		
Chenopodium boscianum —see Chenopodium standleyanum		
Chenopodium foggii	CHENOPODIACEAE	IND.
Chenopodium leptophyllum	CHENOPODIACEAE	IND.
Chenopodium pratericola —see Chenopodium foggii		
Chenopodium rubrum	CHENOPODIACEAE	3:ME
Chenopodium standleyanum	CHENOPODIACEAE	IND.
Chrysopsis falcata —see Pityopsis falcata		
Chrysopsis mariana	ASTERACEAE	2
Cirsium horridulum	ASTERACEAE	IND.
Coelopleurum lucidum —see Angelica lucida		
Coleogeton filiformis ssp. alpinus	POTAMOGETONACEAE	2
Coleogeton filiformis ssp. occidentalis	POTAMOGETONACEAE	2
Collinsia parviflora	SCROPHULARIACEAE	4
Convolvulus spithamaeus —see Calystegia spithamaea		
Corallorhiza odontorhiza	ORCHIDACEAE	3:ME,NH
Coreopsis rosea	ASTERACEAE	1
Cornus florida	CORNACEAE	3:VT
Corydalis aurea	FUMARIACEAE	2
Corydalis flavula	FUMARIACEAE	2
Crataegus bicknellii —see Crataegus × silvestris		
Crataegus chrysocarpa var. *bicknellii* —see Crataegus × silvestris		
Crataegus mollis	ROSACEAE	IND.
Crataegus × silvestris	ROSACEAE	IND.
Crotonopsis elliptica	EUPHORBIACEAE	4
Cryptogramma stelleri	PTERIDACEAE	3:ME
Cuphea viscosissima	LYTHRACEAE	4
Cuscuta coryli	CUSCUTACEAE	2
Cuscuta pentagona	CUSCUTACEAE	IND.
Cynoglossum boreale —see Cynoglossum virginianum var. boreale		

NAME	FAMILY	NEPCoP DIVISION
Cynoglossum virginianum —see Cynoglossum virginianum var. boreale and var. virginianum		
Cynoglossum virginianum var. boreale	BORAGINACEAE	1
Cynoglossum virginianum var. virginianum	BORAGINACEAE	4
Cyperus engelmannii	CYPERACEAE	IND.
Cyperus houghtonii	CYPERACEAE	2
Cyperus odoratus	CYPERACEAE	IND.
Cypripedium arietinum	ORCHIDACEAE	1
Cypripedium calceolus var. *parviflorum* —see Cypripedium parviflorum var. parviflorum		
Cypripedium calceolus var. *pubescens* —see Cypripedium parviflorum var. pubescens		
Cypripedium parviflorum —see Cypripedium parviflorum var. parviflorum		
Cypripedium parviflorum var. makasin	ORCHIDACEAE	IND.
Cypripedium parviflorum var. parviflorum	ORCHIDACEAE	IND.
Cypripedium parviflorum var. pubescens	ORCHIDACEAE	IND.
Cypripedium pubescens —see Cypripedium parviflorum var. pubescens		
Cypripedium reginae	ORCHIDACEAE	3:CT,MA
Dentaria × *incisifolia* —see Cardamine × incisa		
Dentaria laciniata —see Cardamine concatenata		
Dentaria maxima —see Cardamine × maxima		
Deschampsia atropurpurea	POACEAE	2
Descurainia incana —see Descurainia richardsonii		
Descurainia pinnata var. brachycarpa	BRASSICACEAE	2
Descurainia richardsonii	BRASSICACEAE	4
Desmodium canescens	FABACEAE	2
Desmodium cuspidatum	FABACEAE	2
Desmodium glabellum	FABACEAE	2
Desmodium humifusum	FABACEAE	1
Desmodium sessilifolium	FABACEAE	2
Diapensia lapponica	DIAPENSIACEAE	3:VT
Dicentra canadensis	FUMARIACEAE	3:ME
Dichanthelium mattamuskeetense —see Panicum mattamuskeetense		

NAME	FAMILY	NEPCoP DIVISION
Dichanthelium polyanthes —see Panicum polyanthes		
Dichanthelium scabriusculum —see Panicum scabriusculum		
Dichanthelium sphaerocarpon —see Panicum sphaerocarpon		
Dichanthelium sphaerocarpon var. *isophyllum* —see Panicum polyanthes		
Diospyros virginiana	EBENACEAE	2
Diphasiastrum × sabinifolium	LYCOPODIACEAE	2
Diphasiastrum sitchense	LYCOPODIACEAE	2
Diplachne maritima —see Leptochloa fascicularis var. maritima		
Draba arabisans	BRASSICACEAE	2
Draba cana	BRASSICACEAE	2
Draba glabella	BRASSICACEAE	2
Draba lanceolata —see Draba cana		
Draba reptans	BRASSICACEAE	2
Dracocephalum parviflorum	LAMIACEAE	2
Drosera anglica	DROSERACEAE	2
Drosera linearis	DROSERACEAE	2
Dryopteris filix-mas	DRYOPTERIDACEAE	2
Echinodorus parvulus —see Echinodorus tenellus		
Echinodorus tenellus	ALISMATACEAE	1
Echinodorus tenellus var. *parvulus* —see Echinodorus tenellus		
Elatine americana	ELATINACEAE	IND.
Eleocharis equisetoides	CYPERACEAE	2
Eleocharis fallax	CYPERACEAE	2
Eleocharis microcarpa —see Eleocharis microcarpa var. filiculmis		
Eleocharis microcarpa var. filiculmis	CYPERACEAE	2
Eleocharis nitida	CYPERACEAE	IND.
Eleocharis obtusa var. *ovata* —see Eleocharis ovata		
Eleocharis ovata	CYPERACEAE	IND.
Eleocharis ovata var. *heurseri* —see Eleocharis ovata		
Eleocharis pauciflora —see Eleocharis pauciflora var. fernaldii		
Eleocharis pauciflora var. fernaldii	CYPERACEAE	2

NAME	FAMILY	NEPCoP DIVISION
Eleocharis quinqueflora		
—see Eleocharis pauciflora var. fernaldii		
Eleocharis quadrangulata	CYPERACEAE	2
Eleocharis rostellata	CYPERACEAE	IND.
Eleocharis tricostata	CYPERACEAE	2
Eleocharis tuberculosa	CYPERACEAE	3:ME
Elymus mollis		
—see Leymus mollis var. mollis		
Elymus villosus	POACEAE	2
Empetrum nigrum	EMPETRACEAE	3:VT
Epilobium alpinum		
—see Epilobium anagallidifolium		
Epilobium anagallidifolium	ONAGRACEAE	2
Epilobium hornemanni		
—see Epilobium hornemannii		
Epilobium hornemannii	ONAGRACEAE	2
Equisetum × mackaii	EQUISETACEAE	IND.
Eragrostis capillaris	POACEAE	IND.
Erigeron acris var. kamtschaticus	ASTERACEAE	4
Eriocaulon parkeri	ERIOCAULACEAE	1
Eupatorium album	ASTERACEAE	2
Eupatorium aromaticum	ASTERACEAE	2
Eupatorium leucolepis var. novae-angliae	ASTERACEAE	1
Eupatorium perfoliatum var. colpophilum	ASTERACEAE	IND.
Eupatorium rotundifolium var rotundifolium	ASTERACEAE	IND.
Eupatorium sessilifolium	ASTERACEAE	3:VT
Euphorbia glyptosperma	EUPHORBIACEAE	IND.
Euphrasia disjuncta	SCROPHULARIACEAE	4
Euphrasia oakesii	SCROPHULARIACEAE	2
Euthamia galetorum	ASTERACEAE	IND.
Euthamia tenuifolia var. *pycnocephala*		
—see Euthamia galetorum		
Floerkea proserpinacoides	LIMNANTHACEAE	2
Fuirena pumila	CYPERACEAE	3:MA
Galearis spectabilis	ORCHIDACEAE	3:ME
Galium brevipes		
—see Galium trifidum var. trifidum		
Galium kamtschaticum	RUBIACEAE	IND.
Galium labradoricum	RUBIACEAE	3:MA,VT
Galium trifidum var. trifidum	RUBIACEAE	4
Gamochaeta purpurea		
—see Gnaphalium purpureum		

NAME	FAMILY	NEPCoP DIVISION
Gentiana amarella —see Gentianella amarella		
Gentiana andrewsii	GENTIANACEAE	2
Gentiana quinquefolia —see Gentianella quinquefolia		
Gentianella amarella	GENTIANACEAE	2
Gentianella quinquefolia	GENTIANACEAE	2
Geocaulon lividum	SANTALACEAE	2
Geum peckii	ROSACEAE	1
Geum vernum	ROSACEAE	4
Gnaphalium helleri	ASTERACEAE	IND.
Gnaphalium helleri var. *micradenium* —see Gnaphalium helleri		
Gnaphalium purpureum	ASTERACEAE	2
Gnaphalium supinum	ASTERACEAE	2
Gnaphalium sylvaticum	ASTERACEAE	IND.
Goodyera oblongifolia	ORCHIDACEAE	2
Gratiola virginiana	SCROPHULARIACEAE	2
Gymnocarpium jessoense ssp. parvulum	DRYOPTERIDACEAE	4
Habenaria ciliaris —see Platanthera ciliaris		
Habenaria cristata —see Platanthera cristata		
Habenaria leucophaea —see Platanthera leucophaea var. leucophaea		
Hackelia americana —see Hackelia deflexa var. americana		
Hackelia deflexa var. americana	BORAGINACEAE	2
Harrimanella hypnoides	ERICACEAE	2
Helianthemum dumosum	CISTACEAE	1
Heteranthera dubia —see Zosterella dubia		
Heteranthera reniformis	PONTEDERIACEAE	4
Hieracium robinsonii	ASTERACEAE	1
Hieracium umbellatum	ASTERACEAE	2
Hierochloe alpina	POACEAE	2
Hippuris vulgaris	HIPPURIDACEAE	2
Hudsonia tomentosa	CISTACEAE	3:VT
Huperzia appalachiana	LYCOPODIACEAE	IND.
Huperzia selago	LYCOPODIACEAE	IND.
Hybanthus concolor	VIOLACEAE	2
Hydrastis canadensis	RANUNCULACEAE	2
Hydrocotyle verticillata	APIACEAE	2
Hydrophyllum canadense	HYDROPHYLLACEAE	2

NAME	FAMILY	NEPCoP DIVISION
Hypericum adpressum	CLUSIACEAE	1
Hypericum hypericoides ssp. *multicaule* —see Hypericum stragulum		
Hypericum stragulum	CLUSIACEAE	2
Ilex ambigua var. montana	AQUIFOLIACEAE	2
Ilex glabra	AQUIFOLIACEAE	3:ME
Ilex montana —see Ilex ambigua var. montana		
Isanthus brachiatus —see Trichostema brachiatum		
Isoëtes acadiensis	ISOËTACEAE	1
Isoëtes eatonii —see Isoëtes × eatonii		
Isoëtes × eatonii	ISOËTACEAE	IND.
Isoëtes × foveolata	ISOËTACEAE	IND.
Isoëtes lacustris	ISOËTACEAE	IND.
Isoëtes macrospora —see Isoëtes lacustris		
Isoëtes prototypus	ISOËTACEAE	1
Isoëtes riparia	ISOËTACEAE	2
Isoëtes riparia var. *canadensis* —see Isoëtes riparia		
Isotria medeoloides	ORCHIDACEAE	1
Iva frutescens ssp. *oraria* —see Iva frutescens var. oraria		
Iva frutescens var. oraria	ASTERACEAE	3:ME
Juglans cinerea	JUGLANDACEAE	IND.
Juncus alpinoarticulatus —see Juncus alpinus		
Juncus alpinus	JUNCACEAE	2
Juncus biflorus	JUNCACEAE	2
Juncus debilis	JUNCACEAE	2
Juncus oronensis —see Juncus × oronensis		
Juncus × oronensis	JUNCACEAE	IND.
Juncus pervetus	JUNCACEAE	IND.
Juncus stygius var. americanus	JUNCACEAE	2
Juncus subtilis	JUNCACEAE	IND.
Juncus torreyi	JUNCACEAE	2
Juncus trifidus	JUNCACEAE	3:VT
Juncus vaseyi	JUNCACEAE	2
Juniperus horizontalis	CUPRESSACEAE	3:NH,VT
Justicia americana	ACANTHACEAE	4
Krigia biflora	ASTERACEAE	4
Lactuca hirsuta	ASTERACEAE	3:VT

NAME	FAMILY	NEPCoP DIVISION
Lactuca hirsuta var. *sanguinea* —see Lactuca hirsuta		
Lathyrus ochroleucus	FABACEAE	2
Lechea minor	CISTACEAE	IND.
Lemna valdiviana	LEMNACEAE	IND.
Leptochloa fascicularis var. maritima	POACEAE	1
Lespedeza repens	FABACEAE	2
Lespedeza stuevei	FABACEAE	IND.
Leucophysalis grandiflora	SOLANACEAE	4
Leymus mollis var. mollis	POACEAE	IND.
Liatris borealis —see Liatris scariosa var. novae-angliae		
Liatris scariosa var. novae-angliae	ASTERACEAE	1
Lilaeopsis chinensis	APIACEAE	3:ME
Linum medium —see Linum medium var. texanum		
Linum medium var. texanum	LINACEAE	2
Linum sulcatum	LINACEAE	2
Liparis liliifolia	ORCHIDACEAE	2
Liquidambar styraciflua	HAMAMELIDACEAE	2
Listera auriculata	ORCHIDACEAE	1
Listera australis	ORCHIDACEAE	2
Listera cordata	ORCHIDACEAE	3:MA
Lobelia spicata var. hirtella	CAMPANULACEAE	IND.
Loiseleuria procumbens	ERICACEAE	2
Lomatogonium rotatum	GENTIANACEAE	2
Lonicera dioica	CAPRIFOLIACEAE	3:ME
Lonicera hirsuta	CAPRIFOLIACEAE	2
Lonicera sempervirens	CAPRIFOLIACEAE	IND.
Ludwigia polycarpa	ONAGRACEAE	2
Ludwigia sphaerocarpa	ONAGRACEAE	2
Lupinus perennis	FABACEAE	3:CT,MA, NH,RI,VT
Luzula confusa	JUNCACEAE	2
Luzula spicata	JUNCACEAE	2
Lycopodiella alopecuroides	LYCOPODIACEAE	2
Lycopodium alopecuroides —see Lycopodiella alopecuroides		
Lycopodium carolinianum —see Pseudolycopodiella caroliniana		
Lycopodium sabinifolium —see Diphasiastrum × sabinifolium		
Lycopodium selago —see Huperzia selago		

NAME	FAMILY	NEPCoP DIVISION
Lycopodium sitchense —see Diphasiastrum sitchense		
Lycopus rubellus	LAMIACEAE	2
Lygodium palmatum	LYGODIACEAE	3:CT,VT
Lyonia mariana	ERICACEAE	4
Lythrum alatum var. alatum	LYTHRACEAE	IND.
Magnolia virginiana	MAGNOLIACEAE	2
Malaxis bayardii	ORCHIDACEAE	1
Melampyrum lineare var. latifolium	SCROPHULARIACEAE	IND.
Melampyrum lineare var. lineare	SCROPHULARIACEAE	IND.
Melampyrum lineare var. pectinata	SCROPHULARIACEAE	IND.
Melanthium hybridum	LILIACEAE	4
Mertensia maritima	BORAGINACEAE	3:MA
Mimulus alatus	SCROPHULARIACEAE	2
Mimulus moschatus	SCROPHULARIACEAE	2
Mimulus ringens var. colpophilus	SCROPHULARIACEAE	IND.
Minuartia caroliniana —see Arenaria caroliniana		
Minuartia glabra	CARYOPHYLLACEAE	2(a)
Minuartia groenlandica	CARYOPHYLLACEAE	3:VT
Minuartia marcescens	CARYOPHYLLACEAE	1
Minuartia rubella	CARYOPHYLLACEAE	2
Moehringia macrophylla	CARYOPHYLLACEAE	2
Monarda punctata var. villicaulis	LAMIACEAE	2
Montia fontana	PORTULACACEAE	2
Morus rubra	MORACEAE	2
Muhlenbergia capillaris	POACEAE	2
Muhlenbergia richardsonis	POACEAE	2
Muhlenbergia sobolifera	POACEAE	3:ME
Myriophyllum pinnatum	HALORAGACEAE	IND.
Myriophyllum verticillatum	HALORAGACEAE	IND.
Najas guadalupensis	NAJADACEAE	IND.
Neobeckia aquatica	BRASSICACEAE	2
Nuphar advena —see Nuphar lutea ssp. advena		
Nuphar lutea ssp. advena	NYMPHAEACEAE	IND.
Nymphaea leibergii	NYMPHAEACEAE	2
Nymphaea odorata ssp. tuberosa	NYMPHAEACEAE	IND.
Nymphaea odorata var. *tuberosa* —see Nymphaea odorata ssp. tuberosa		

NAME	FAMILY	NEPCoP DIVISION
Nymphaea tetragona —see Nymphaea leibergii		
Nymphaea tuberosa —see Nymphaea odorata ssp. tuberosa		
Oenothera fruticosa	ONAGRACEAE	IND.
Omalotheca supina —see Gnaphalium supinum		
Omalotheca sylvatica —see Gnaphalium sylvaticum		
Onosmodium virginianum	BORAGINACEAE	2
Ophioglossum pusillum	OPHIOGLOSSACEAE	3:MA,RI,CT
Ophioglossum vulgatum —see Ophioglossum pusillum		
Orchis rotundifolia —see Amerorchis rotundifolia		
Orchis spectabilis —see Galearis spectabilis		
Oryzopsis canadensis	POACEAE	4
Osmorhiza berteroi —see Osmorhiza chilensis		
Osmorhiza chilensis	APIACEAE	2
Osmorhiza depauperata	APIACEAE	4
Osmorhiza obtusa —see Osmorhiza depauperata		
Oxalis violacea	OXALIDACEAE	2
Oxyria digyna	POLYGONACEAE	2
Oxytropis campestris var. johannensis	FABACEAE	1
Panicum amarum	POACEAE	2
Panicum dichotomum ssp. *mattamuskeetense* —see Panicum mattamuskeetense		
Panicum flexile	POACEAE	2
Panicum gattingeri	POACEAE	2
Panicum longifolium —see Panicum rigidulum var. pubescens		
Panicum mattamuskeetense	POACEAE	IND.
Panicum polyanthes	POACEAE	IND.
Panicum rigidulum var. pubescens	POACEAE	2
Panicum scabriusculum	POACEAE	2
Panicum sphaerocarpon	POACEAE	IND.
Panicum stipitatum	POACEAE	4
Paronychia argyrocoma	CARYOPHYLLACEAE	2(a)
Paronychia argyrocoma var. *albimontana* —see Paronychia argyrocoma		
Paronychia canadensis	CARYOPHYLLACEAE	3:VT

NAME	FAMILY	NEPCoP DIVISION
Paronychia fastigiata	CARYOPHYLLACEAE	IND.
Paspalum laeve	POACEAE	2
Paspalum setaceum var. psammophilum	POACEAE	2
Pedicularis furbishiae	SCROPHULARIACEAE	1
Pedicularis lanceolata	SCROPHULARIACEAE	2
Persicaria vivipara —see Polygonum viviparum		
Phaseolus polystachios	FABACEAE	4
Phaseolus polystachios var. *aquilonius* —see Phaseolus polystachios		
Phleum alpinum	POACEAE	2
Phyllodoce caerulea	ERICACEAE	2
Physalis grandiflora —see Leucophysalis grandiflora		
Physalis longifolia var. subglabrata	SOLANACEAE	IND.
Physalis subglabrata —see Physalis longifolia var. subglabrata		
Pilea fontana	URTICACEAE	IND.
Pinguicula vulgaris	LENTIBULARIACEAE	2
Pityopsis falcata	ASTERACEAE	1
Platanthera ciliaris	ORCHIDACEAE	2
Platanthera cristata	ORCHIDACEAE	2
Platanthera leucophaea var. leucophaea	ORCHIDACEAE	1
Poa arctica —see Poa pratensis ssp. alpigena		
Poa fernaldiana —see Poa laxa ssp. fernaldiana		
Poa glauca	POACEAE	2
Poa laxa ssp. fernaldiana	POACEAE	1
Poa pratensis ssp. alpigena	POACEAE	IND.
Podophyllum peltatum	BERBERIDACEAE	2
Polemonium van-bruntiae	POLEMONIACEAE	1
Polygala senega	POLYGALACEAE	2
Polygala verticillata	POLYGALACEAE	IND.
Polygala verticillata var. *ambigua* —see Polygala verticillata		
Polygonum douglasii	POLYGONACEAE	2
Polygonum erectum	POLYGONACEAE	IND.
Polygonum glaucum	POLYGONACEAE	1
Polygonum hydropiperoides var. *setaceum* —see Polygonum setaceum var. interjectum		
Polygonum puritanorum	POLYGONACEAE	IND.

NAME	FAMILY	NEPCoP DIVISION
Polygonum setaceum var. interjectum	POLYGONACEAE	IND.
Polygonum tenue	POLYGONACEAE	3:VT
Polygonum viviparum	POLYGONACEAE	2
Polymnia canadensis	ASTERACEAE	2
Populus heterophylla	SALICACEAE	2
Potamogeton confervoides	POTAMOGETONACEAE	1
Potamogeton diversifolius	POTAMOGETONACEAE	IND.
Potamogeton filiformis var. *alpinus* —see Coleogeton filiformis ssp. alpinus		
Potamogeton filiformis var. *borealis* —see Coleogeton filiformis ssp. alpinus		
Potamogeton filiformis var. *occidentalis* —see Coleogeton filiformis ssp. occidentalis		
Potamogeton hillii	POTAMOGETONACEAE	1
Potamogeton ogdenii	POTAMOGETONACEAE	1
Potamogeton pusillus ssp. gemmiparus	POTAMOGETONACEAE	IND.
Potamogeton strictifolius	POTAMOGETONACEAE	IND.
Potamogeton vaseyi	POTAMOGETONACEAE	2
Potentilla pectinata —see Potentilla pensylvanica var. bipinnatifida		
Potentilla pensylvanica var. bipinnatifida	ROSACEAE	IND.
Potentilla pensylvanica var. *pectinata* —see Potentilla pensylvanica var. bipinnatifida		
Potentilla robbinsiana	ROSACEAE	1
Prenanthes boottii	ASTERACEAE	1
Prenanthes × mainensis	ASTERACEAE	IND.
Prenanthes racemosa	ASTERACEAE	2
Prenanthes serpentaria	ASTERACEAE	2
Primula laurentiana	PRIMULACEAE	2
Primula mistassinica	PRIMULACEAE	3:VT
Prunus alleghaniensis	ROSACEAE	4
Prunus maritima var. gravesii	ROSACEAE	IND.
Pseudolycopodiella caroliniana	LYCOPODIACEAE	4
Psilocarya nitens —see Rhynchospora nitens		
Pterospora andromedea	PYROLACEAE	2
Puccinellia langeana ssp. *alascana* —see Puccinellia tenella ssp. alascana		
Puccinellia paupercula var. *alaskana* —see Puccinellia tenella ssp. alascana		
Puccinellia tenella ssp. alascana	POACEAE	IND.
Puccinellia tenella ssp. langeana	POACEAE	IND.

NAME	FAMILY	NEPCoP DIVISION
Pycnanthemum clinopodioides	LAMIACEAE	IND.
Pycnanthemum torrei	LAMIACEAE	IND.
Pyrola minor	PYROLACEAE	3:VT
Ranunculus allegheniensis	RANUNCULACEAE	2
Ranunculus ambigens	RANUNCULACEAE	2
Ranunculus gmelinii var. hookeri	RANUNCULACEAE	2
Ranunculus gmelinii var. *purshii*		
—see Ranunculus gmelinii var. hookeri		
Ranunculus hispidus	RANUNCULACEAE	IND.
Ranunculus lapponicus	RANUNCULACEAE	2
Ranunculus micranthus	RANUNCULACEAE	2
Rhexia mariana	MELASTOMATACEAE	2
Rhinanthus crista-galli	SCROPHULARIACEAE	IND.
Rhinanthus minor		
—see Rhinanthus crista-galli		
Rhododendron lapponicum	ERICACEAE	2
Rhododendron maximum	ERICACEAE	3:ME,VT
Rhododendron viscosum	ERICACEAE	3:ME
Rhynchospora capillacea	CYPERACEAE	2
Rhynchospora inundata	CYPERACEAE	2
Rhynchospora nitens	CYPERACEAE	2
Rhynchospora torreyana	CYPERACEAE	2
Ribes rotundifolium	GROSSULARIACEAE	IND.
Rosa acicularis		
—see Rosa acicularis ssp. sayi		
Rosa acicularis ssp. sayi	ROSACEAE	2
Rosa blanda var. glabra	ROSACEAE	IND.
Rosa johannensis		
—see Rosa blanda var. glabra		
Rotala ramosior	LYTHRACEAE	2
Rubus aculiferus	ROSACEAE	IND.
Rubus × *aculiferus*		
—see Rubus aculiferus		
Rubus cuneifolius	ROSACEAE	2
Rumex fenestratus		
—see Rumex occidentalis		
Rumex occidentalis	POLYGONACEAE	4
Sabatia campanulata	GENTIANACEAE	2
Sabatia dodecandra	GENTIANACEAE	4
Sabatia kennedyana	GENTIANACEAE	1
Sabatia stellaris	GENTIANACEAE	2
Sagina decumbens	CARYOPHYLLACEAE	IND.
Sagina nodosa ssp. borealis	CARYOPHYLLACEAE	2
Sagina nodosa var. *borealis*		
—see Sagina nodosa ssp. borealis		

NAME	FAMILY	NEPCoP DIVISION
Sagina nodosa ssp. nodosa	CARYOPHYLLACEAE	IND.
Sagittaria rigida	ALISMATACEAE	3:ME
Sagittaria subulata	ALISMATACEAE	2
Sagittaria teres	ALISMATACEAE	1
Salix arctophila	SALICACEAE	2
Salix argyrocarpa	SALICACEAE	2
Salix candida	SALICACEAE	3:ME
Salix cordata	SALICACEAE	IND.
Salix exigua —see Salix exigua ssp. interior		
Salix exigua ssp. interior	SALICACEAE	3:ME
Salix herbacea	SALICACEAE	2
Salix interior —see Salix exigua ssp. interior		
Salix myricoides	SALICACEAE	2
Salix planifolia	SALICACEAE	2
Salix uva-ursi	SALICACEAE	2
Sanicula canadensis	APIACEAE	2
Saururus cernuus	SAURURACEAE	2
Saxifraga aizoides	SAXIFRAGACEAE	2
Saxifraga aizoon var. *neogaea* —see Saxifraga paniculata		
Saxifraga cernua	SAXIFRAGACEAE	2
Saxifraga foliolosa	SAXIFRAGACEAE	2
Saxifraga oppositifolia	SAXIFRAGACEAE	2
Saxifraga paniculata	SAXIFRAGACEAE	2
Saxifraga rivularis	SAXIFRAGACEAE	2
Saxifraga stellaris var. *comosa* —see Saxifraga foliolosa		
Schoenoplectus etuberculatus	CYPERACEAE	1
Schoenoplectus hallii	CYPERACEAE	4
Schoenoplectus heterochaetus	CYPERACEAE	IND.
Schoenoplectus × steinmetzii	CYPERACEAE	IND.
Schwalbea americana	SCROPHULARIACEAE	4
Scirpus ancistrochaetus	CYPERACEAE	1
Scirpus clintonii —see Trichophorum clintonii		
Scirpus cylindricus —see Bolboschoenus novae-angliae		
Scirpus etuberculatus —see Schoenoplectus etuberculatus		
Scirpus hallii —see Schoenoplectus hallii		
Scirpus heterochaetus —see Schoenoplectus heterochaetus		

NAME	FAMILY	NEPCoP DIVISION
Scirpus longii	CYPERACEAE	1
Scirpus maritimus —see Bolboschoenus maritimus		
Scirpus paludosus var. *atlanticus* —see Bolboschoenus maritimus		
Scirpus pendulus	CYPERACEAE	3:ME
Scirpus polyphyllus	CYPERACEAE	2
Scirpus steinmetzii —see Schoenoplectus × steinmetzii		
Scleria pauciflora	CYPERACEAE	2
Scleria pauciflora var. *caroliniana* —see Scleria pauciflora		
Scleria reticularis	CYPERACEAE	1
Scleria triglomerata	CYPERACEAE	2
Scleria verticillata	CYPERACEAE	4
Sclerolepis uniflora	ASTERACEAE	2
Scutellaria integrifolia	LAMIACEAE	2
Scutellaria leonardii	LAMIACEAE	2
Scutellaria parvula var. *leonardi* —see Scutellaria leonardii		
Scutellaria parvula var. parvula	LAMIACEAE	2
Sedum rosea	CRASSULACEAE	3:VT
Selaginella eclipes	SELAGINELLACEAE	IND.
Senna hebecarpa	CAESALPINIACEAE	2
Shepherdia canadensis	ELAEAGNACEAE	3:ME
Sibbaldia procumbens	ROSACEAE	2
Silene acaulis	CARYOPHYLLACEAE	2
Silene acaulis var. *exscapa* —see Silene acaulis		
Silene stellata	CARYOPHYLLACEAE	2
Sisyrinchium mucronatum	IRIDACEAE	2
Smilax hispida —see Smilax tamnoides		
Smilax tamnoides	SMILACACEAE	4
Smilax tamnoides var. *hispida* —see Smilax tamnoides		
Solidago calcicola —see Solidago × calcicola		
Solidago × calcicola	ASTERACEAE	4
Solidago canadensis var. subserrata	ASTERACEAE	IND.
Solidago cutleri	ASTERACEAE	2
Solidago glutinosa ssp. *randii* —see Solidago simplex ssp. randii var. monticola		
Solidago lepida var. *molina* —see Solidago canadensis var. subserrata		

NAME	FAMILY	NEPCoP DIVISION
Solidago multiradiata var. *arctica* —see Solidago cutleri		
Solidago ptarmicoides	ASTERACEAE	2
Solidago rigida	ASTERACEAE	2
Solidago simplex ssp. randii var. monticola	ASTERACEAE	3:MA,NH
Solidago simplex var. *randii* —see Solidago simplex ssp. randii var. monticola		
Sorghastrum nutans	POACEAE	3:ME
Sparganium minimum	SPARGANIACEAE	3:MA
Sparganium natans —see Sparganium minimum		
Spartina cynosuroides	POACEAE	2
Sphenopholis nitida	POACEAE	2
Sphenopholis obtusata	POACEAE	IND.
Sphenopholis pensylvanica	POACEAE	2
Spiranthes casei	ORCHIDACEAE	IND.
Spiranthes × intermedia	ORCHIDACEAE	IND.
Sporobolus asper —see Sporobolus compositus var. compositus		
Sporobolus clandestinus	POACEAE	4
Sporobolus compositus var. compositus	POACEAE	2
Sporobolus heterolepis	POACEAE	2
Sporobolus neglectus	POACEAE	2
Stachys hyssopifolia	LAMIACEAE	3:CT
Stachys palustris ssp. *pilosa* —see Stachys pilosa		
Stachys pilosa	LAMIACEAE	IND.
Stachys tenuifolia	LAMIACEAE	IND.
Stachys tenuifolia var. *platyphylla* —see Stachys tenuifolia		
Strophostyles umbellata	FABACEAE	4
Suaeda americana	CHENOPODIACEAE	IND.
Suaeda calceoliformis —see Suaeda americana		
Suaeda maritima	CHENOPODIACEAE	IND.
Suaeda maritima ssp. *richii* —see Suaeda maritima		
Subularia aquatica	BRASSICACEAE	2
Symphoricarpos albus var. albus	CAPRIFOLIACEAE	3:MA
Synosma suaveolens —see Cacalia suaveolens		
Taenidia integerrima	APIACEAE	2

NAME	FAMILY	NEPCoP DIVISION
Tanacetum bipinnatum ssp. huronense	ASTERACEAE	2(a)
Tanacetum huronense —see Tanacetum bipinnatum ssp. huronense		
Taraxacum ceratophorum	ASTERACEAE	IND.
Taraxacum latilobum —see Taraxacum ceratophorum		
Tipularia discolor	ORCHIDACEAE	2
Tofieldia glutinosa	LILIACEAE	3:NH,VT
Trichomanes intricatum	HYMENOPHYLLACEAE	1
Trichophorum clintonii	CYPERACEAE	2
Trichostema brachiatum	LAMIACEAE	2
Triglochin gaspense	JUNCAGINACEAE	4
Trimorpha acris var. *kamtschatica* —see Erigeron acris var. kamtschaticus		
Triosteum angustifolium	CAPRIFOLIACEAE	4
Triosteum aurantiacum	CAPRIFOLIACEAE	3:ME
Triosteum perfoliatum	CAPRIFOLIACEAE	2
Triphora trianthophora	ORCHIDACEAE	2(a)
Tripsacum dactyloides	POACEAE	2
Trisetum melicoides	POACEAE	2
Trollius laxus	RANUNCULACEAE	1
Trollius laxus ssp. *laxus* —see Trollius laxus		
Ulmus thomasi	ULMACEAE	4
Utricularia biflora	LENTIBULARIACEAE	2
Utricularia fibrosa	LENTIBULARIACEAE	2
Utricularia inflata	LENTIBULARIACEAE	IND.
Utricularia resupinata	LENTIBULARIACEAE	2(a)
Utricularia subulata	LENTIBULARIACEAE	2
Vaccinium boreale	ERICACEAE	1
Vaccinium vitis-idaea ssp. *minus* —see Vaccinium vitis-idaea var. minus		
Vaccinium vitis-idaea var. minus	ERICACEAE	3:NH,MA
Vahlodea atropurpurea —see Deschampsia atropurpurea		
Valeriana uliginosa	VALERIANACEAE	2
Valerianella radiata	VALERIANACEAE	4
Valerianella radiata var. *fernaldiana* —see Valerianella radiata		
Verbena simplex	VERBENACEAE	2
Veronica anagallis-aquatica —see Veronica catenata		
Veronica catenata	SCROPHULARIACEAE	IND.
Veronica wormskjoldii	SCROPHULARIACEAE	2

NAME	FAMILY	NEPCoP DIVISION
Veronicastrum virginicum	SCROPHULARIACEAE	IND.
Viburnum nudum —see Viburnum nudum var. nudum		
Viburnum nudum var. nudum	CAPRIFOLIACEAE	2
Viburnum prunifolium	CAPRIFOLIACEAE	2
Viburnum rafinesquianum	CAPRIFOLIACEAE	3:NH
Viola brittoniana	VIOLACEAE	2
Viola hirsutula	VIOLACEAE	4
Viola novae-angliae	VIOLACEAE	2
Viola palmata	VIOLACEAE	IND.
Viola palustris	VIOLACEAE	2
Viola pedatifida ssp. *brittoniana* —see Viola brittoniana		
Viola striata	VIOLACEAE	IND.
Viola subsinuata	VIOLACEAE	IND.
Viola triloba var. *dilatata* —see Viola palmata		
Waldsteinia fragarioides	ROSACEAE	3:ME
Wolffiella floridana —see Wolffiella gladiata		
Wolffiella gladiata	LEMNACEAE	2
Woodsia alpina	DRYOPTERIDACEAE	2
Xyris smalliana	XYRIDACEAE	3:ME
Zigadenus elegans var. glaucus	LILIACEAE	4
Zigadenus glaucus —see Zigadenus elegans var. glaucus		
Zizia aptera	APIACEAE	2
Zosterella dubia	PONTEDERIACEAE	3:ME

THE NEW ENGLAND BOTANICAL CLUB
22 Divinity Avenue
Cambridge, MA 02138

The New England Botanical Club is a non-profit organization that promotes the study of plants of North America, especially the flora of New England and adjacent areas. The Club holds regular meetings, and has a large herbarium of New England plants and a library. It publishes a quarterly journal, RHODORA, which is now in its 99th year and contains about 400 pages per volume. Visit our web site at http://www.herbaria.harvard.edu/nebc/

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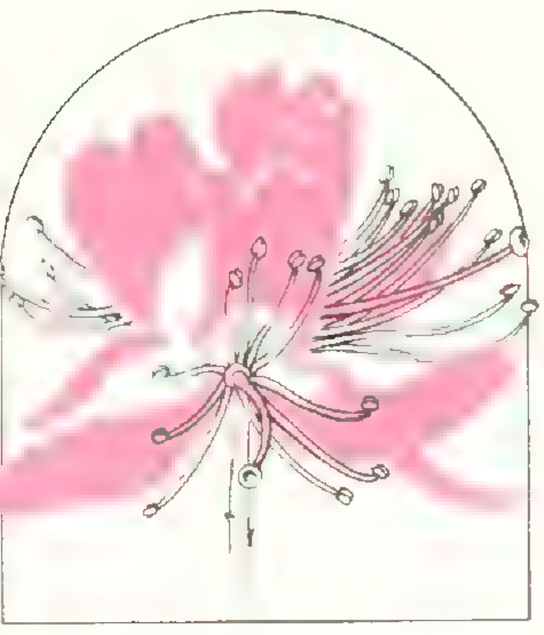

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Vol. 98 **Autumn, 1996** **No. 896**

Issued: August 13, 1997

The New England Botanical Club, Inc.

22 Divinity Avenue, Cambridge, Massachusetts 02138

RHODORA

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RHODORA (ISSN 0035-4902). Published four times a year (January, April, July, and October) by The New England Botanical Club, 810 East 10th St., Lawrence, KS 66044 and printed by Allen Press, Inc., 1041 New Hampshire St., Lawrence, KS 66044-0368. Periodicals postage paid at Lawrence, KS. POSTMASTER: Send address changes to RHODORA, P.O. Box 1897, Lawrence, KS 66044-8897.

RHODORA is a journal of botany devoted primarily to the flora of North America. Monographs or scientific papers concerned with systematics, floristics, ecology, paleobotany, or conservation biology of the flora of North America or floristically related areas will be considered.

SUBSCRIPTIONS: $75 per calendar year, net, postpaid, in funds payable at par in United States currency. Remittances payable to RHODORA. Send to RHODORA, P.O. Box 1897, Lawrence, KS 66044-8897.

MEMBERSHIPS: Regular $35; Family $45; Student $25. Application form printed herein.

NEBC WEB SITE: Information about The New England Botanical Club, its history, officers and councillors, herbarium, monthly meetings and special events, annual graduate student award, and the journal RHODORA is available at http://www.herbaria.harvard.edu/nebc/

BACK ISSUES: Information on availability of back issues should be addressed to Dr. Cathy A. Paris, Department of Botany, University of Vermont, Burlington, VT 05405-0086. E-mail: cparis@moose.uvm.edu.

ADDRESS CHANGES: In order to receive the next number of RHODORA, changes must be received by the business office prior to the first day of January, April, July, or October.

INFORMATION FOR CONTRIBUTORS: See contents. Submit manuscripts to the Editor-in-Chief.

♾ This paper meets the requirements of ANSI/NISO Z39.48-1992 (Permanence of Paper).

RHODORA, Vol. 98, No. 896, pp. 365–368, 1996

HEUCHERA MICRANTHA VAR. *MACROPETALA* (SAXIFRAGACEAE), A NEW VARIETY

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ABSTRACT. This newly described variety of *Heuchera micrantha* is characterized by the presence of widely ovate petals, a cyathiform calyx, and in general, a taller inflorescence than the other varieties of *H. micrantha*. Clearly different from the other varieties of *H. micrantha* in the shape of the flower, in the greater width of the petal, and in having fewer flowers per lateral branch of the inflorescence, it appears to be distinct at the varietal level. The cyathiform calyx is not found in any other *H. micrantha* variety. The exserted stigmas and stamens, the size of the flower, the leaf shape, and indumentum are characters held in common with the other varieties of *H. micrantha,* which place this taxon within our circumscription of the species.

Key Words: *Heuchera micrantha* var. *macropetala, Micranthae,* var. nov., cyathiform calyx

In their monograph on *Heuchera,* Rosendahl, Butters, and Lakela (1936) treated *H. micrantha* as a polymorphic species with five varieties and two forms. From locations in the Siskiyou (Oregon and California) and Klamath (California) Mountains they reported the existence of a number of specimens which fit no varietal description and which they identified as transitional forms. Since the publication of their work, specimens from the same populations within these locations collected in different years have been identified as *H. micrantha* var. *micrantha, H. micrantha* var. *pacifica, H. micrantha* var. *erubescens,* and *H. pilosissima.* Some of these populations share a stable set of morphological characteristics and, in a recent revision of *Micranthae* and *Pilosissimae* of *Heuchera* in the Saxifragaceae (Shipes 1988), a new variety of *Heuchera micrantha* has been recognized in this region of northern California and southern Oregon. For clarity and bibliographic convenience, the new variety is validated, described, and briefly explained here.

Heuchera micrantha Dougl. ex Lindl. var. **macropetala** Shipes & Wells, *var. nov.* TYPE: Oregon, Curry Co., Big Craggy, 12 Jun 1933, *L. Leach s.n.* (HOLOTYPE: ORE!; ISOTYPE: OSU!)

Calycibus cyathiformibus usque ad non profunde turbinatis; petalis late ovatis, vix unguiculatis, cum tribus typis venationis: (1) una vena principalis cum 2–4 venis lateralibus; (2) una vena media; (3) venatio imperfecta suprabasalaris acrodroma (3–5).

Leaf blade semi-orbicular to pentagonal, at least 3 leaf forms on each plant: (1) blade semi-orbicular with 7 very shallow lobes, each lobe with lateral lobes; (2) blade pentagonal, the length equal to the width, with 5–7 lobes, each lobe with lateral lobes; (3) blade pentagonal, the length greater than the width, with 7 lobes, blade 3.5–7.0 cm from base to apex, 2.4–7.0 cm wide, main lobes somewhat spreading with crenate sublobes. In all three forms the lobe apices and teeth are cuspidate to acute apiculate (1.0 mm vein extension); leaf bases cordate; margins sparingly ciliate; upper leaf surface glabrous to sparsely strigose; lower leaf surface sparsely villous to strigose on veins; petioles 4.2–15.0 cm long, puberulent, sometimes sparsely villous. Inflorescences 6.0–57.0 cm tall, somewhat lax, 2.3–11.0 cm broad, lateral axes with short, even puberulence, sometimes sparingly villous; peduncle bracts scarious, lanceolate to linear, occasionally large, similar to basal leaves in shape but never as large; bracts subtending floral branches herbaceous, margins divided, divisions with aristate tips. Calyces cyathiform (shaped like a small, shallow bowl) to shallowly turbinate, 1.0–3.4 mm long and 1.3–3.6 mm wide at anthesis; free hypanthia 1.1 mm long; sepal lobes usually white with green or red tips, rounded, 0.5–1.5 mm long. Petals white, widely ovate, barely clawed, with three types of venation: (1) one main vein and 2–4 almost parallel lateral veins; (2) single mid-vein; (3) 3–5 secondary veins branching suprabasally from one main vein; 1.5–3.5 mm long, 0.4–1.4 mm wide with puberulent patches in the upper 1/3 of the blade; margins entire. Stamens at anthesis exserted 1.0–3.2 mm beyond calyx. Styles at anthesis exserted 0.1–2.5 mm from calyx, length of style and portion of the ovary above the hypanthium at anthesis 1.2–3.9 mm. Capsules exserted, 2.5–5.0 mm long excluding persistent styles; seeds dark brown, echinate, 0.7 mm long, 0.4 mm wide.

PHENOLOGY. Flowering from middle of April through middle of June.

HABITAT. Mixed evergreen forest on either limestone or serpentine base, in the Klamath Mountains of California and the Siskiyou Mountains of California and Oregon. Latitude 40–43°N.

This newly described variety is characterized by the presence of widely ovate petals, a cyathiform calyx, and in general, a taller inflorescence than the other varieties of *Heuchera micrantha.* Based on floral, fruit, and inflorescence characters, it appears to be distinct at the varietal level. It is clearly distinct from the other varieties of *H. micrantha* in the shape of the flower, in the greater petal width, and in having fewer flowers per lateral branch of the inflorescence. The cyathiform calyx is not found in any other *H. micrantha* variety. However, the exserted stigmas and stamens, the size of the flower, the leaf shape, and indumentum are characters held in common with the other varieties of *H. micrantha,* which place this taxon within our circumscription of the species.

REPRESENTATIVE SPECIMENS. OREGON: Curry Co., Bald Mt. Creek, NW exposure, McGribble Forest Service Camp, T33S, R24W, Sect. 20, *Detling 5880* (ORE); Rogue River Canyon, rock ledges along Rogue River W of Brushy Bar, *Baker 3832* (JEPS, UC); Squirrel Camp, *Leach 1889* (ORE, OSC); Big Craggy, 6/12/33, *Leach s.n.* (ORE, OSU); Forest Service Rd. #333 (Powers-Agness Rd.), 3 mi N of the jct with #330, Agness vicinity, *Crosby 1224* (ORE); Siskiyou National Forest, 16–18 mi W of jct of Hwy. 199 with Forest Service Rd. 3807 on 3807 (Rd. to Kalmiopsis Wilderness), *Denton 2350* (OSC, UW); Josephine Co., Mouse Creek on Rogue River, 2.3 mi upstream from bridge at mouth of Graves Creek, *Crosby 1154* (DH, ORE, OSC); Graves Creek Rd., 1 mi E of jct of Graves Creek with Rogue River, T33S; R7W, Sect. 31, *Crosby 1153* (OSC); Siskiyou National Forest, 20–23 mi NW of Selma on the Illinois River Rd. or 8–11 mi N of jct with Rt. 374 on Forest Service Rd. 3504, *Denton 2475* (UW); Lane Co., Ollalie Trail in Willamette National Forest, T16S, R5E, *Ireland 1117* (ORE); CALIFORNIA: Humboldt Co., Horse Mt., T6N, R4E, Sect. 34, *Klipfel 676, 680* (HSC); Little Horse Linto Creek below Grizzly Camp, *Tracy 18976* (UC); Willow Creek, E fork, T6N, R4E, Sect. 15, 34 mi from US 101 along State Rt. 299, *Reed 66* (HSC); Shasta Co., Redding, 25 mi E, *Hitchcock 6481* (POM, UW); Siskiyou Co., State Rt. 299, 0.2 mi E of jct with Hennessey Rd., 4/30/72, *Sawyer, s.n.* (HSC); rd. between Forks of Salmon & Somes Bar, *Smith 8695* (HSC); Kangaroo Mt. above Toehead Lake, T18N, R12W, Sect. 16, *Smith, Sawyer, & O'Mear 5675* (HSC); Salmon River, S fork of road 4 mi E of Cecilville, *Irwin 44501* (HSC); Salmon River, 10 mi SE T10N, R6E, Sect. 30, *Miller 10108* (HSC, RSA); Slater Butte & Indian Creek, Klamath National Forest, *Detling 6098* (ORE); Trinity Co., Burnt Ranch, 8 mi W on Underwood Mt. Rd., *Spellenberg 454* (HSC); Canyon Creek above McKay Camp, *Ferlatte 65* (HSC, RSA); Gray Falls, trails above the Trinity River, Humboldt Meridian, T6N, R7W, Sect. 34, *Smith 8098* (HSC, RSA); Gray Falls, New River Trail, T6N, R6E, Sect. 35, *Lundquist 58* (HSC);

Gray Falls Campground above the Trinity River, *DeTomaso 924* (HSC); Hobo Gulch Camp and vicinity (18 mi NW of Weaverville, along N fork of trail at the washout below Struce Cabin), *Carter 546* (CAS); Ironside Mt. Quad. T6N, R6E, Sect. 35, *Sawyer 2499* (HSC), *Sawyer 2601* (HSC); White's Bar, above State Rt. 299, *Sawyer & Cole* (HSC).

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RHODORA, Vol. 98, No. 896, pp. 369–418, 1996

A COMPARISON OF INSULAR SEAWEED FLORAS FROM PENOBSCOT BAY, MAINE, AND OTHER NORTHWEST ATLANTIC ISLANDS

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ABSTRACT. Ninety-seven taxa of seaweeds were collected from nine islands within the Penobscot Bay area of central Maine, including 25 Chlorophyceae, 34 Phaeophyceae, and 38 Rhodophyceae. The patterns of species richness and longevity (#annuals/#perennials) per island are highly variable, with species richness ranging from only 4 taxa on Allen I. to 65 on Wooden Ball I. (mean = 30.8 ± 23.0 taxa) and longevity ratios varying from 0.33–1.0 (0.64 ± 28.1). A total of 48 annuals and 49 perennials is recorded throughout the Bay, giving a longevity ratio of 0.98. This value is lower than that found at many open coastal habitats within the Gulf of Maine. An examination of historical collections by J. Hooper and F. S. Collins from the 1800s revealed three unusual coastal records (*Stilophora rhizoides, Gracilaria tikvahiae,* and *Cladophora ruchingeri*) and sixteen additional seaweeds that were not encountered in our study. Based upon these historical and present collections, as well as extensive sampling from more than 70 nearshore sites, a total of 139 seaweed taxa is known from the Penobscot Bay area, including 40 Chlorophyceae, 47 Phaeophyceae and 52 Rhodophyceae. In a comparison of seaweed floras from fourteen individual islands, from South Wolf I., New Brunswick, to Penikese I., Massachusetts (including a "composite" of Penobscot Bay Islands), 216 seaweed taxa are documented, including 52 Chlorophyceae, 63 Phaeophyceae, and 101 Rhodophyceae. The highest numbers of taxa occur at Smuttynose I., Maine (136), and Penikese I., Massachusetts (131), and the lowest on Wooden Ball I., Maine (65), Monhegan I., Maine (64), and Kent I., New Brunswick (63). Floristic affinities of individual islands tend to mimic patterns of species richness, with Smuttynose having the highest number of shared taxa (mean = 92.4 ± 20.2) and Kent and Wooden Ball Islands the lowest numbers (mean = 50.8 ± 5.2 and 53.9 ± 6.2, respectively). The seaweed diversity of Penikese Island and nearby environs (187 taxa) is comparable to the entire Gulf of Maine.

Key Words: seaweeds, coastal islands, Penobscot Bay, Maine, New Brunswick, New Hampshire, Massachusetts, Gulf of Maine

As noted by Hill (1923), and Pike and Hodgdon (1963), comparative floristic investigations of islands have been grossly neglected within North America, even though there have been many fine studies of individual islands. Although their statement applies

Table 1. Dates and locations of insular collections within the Penobscot Bay area of mid-coastal Maine. Symbols: X = intertidal; X* = subtidal; X** = intertidal and subtidal.

Islands	1985				
	6/2	6/6	6/9	6/11	6/12
Allen I.					
Hurricane I.				X	X
Long I.					
Marshall I.		X			
McGlathery I.			X**		
Monhegan I.					
Pond I.					
Two Bush I.				X	
Wooden Ball I.	X				

to terrestrial vegetation, it is equally true for marine floras (Bowers 1942; Collins 1900; Doty 1948; Koetzner and Wood 1972; Lewis 1924; Scagel 1970; Sears and Wilce 1975). For example, along Maine's extensive and indented coastline there are some two thousand islands (Platt 1996; Simpson 1987), but little attention has been paid to their marine algal floras. Johnson and Skutch (1928a, b) conducted an early ecological study of intertidal algal associations on Mount Desert Island in Bar Harbor, Maine, including a synopsis of species composition, zonation, and ecology. It is still one of the most significant studies of its kind for any Maine island. The only floristic synopsis of multiple insular sites within the Gulf of Maine was conducted at the Isles of Shoals in southern Maine and New Hampshire (Mathieson and Penniman 1986b). We are aware of only one other comparative study of insular marine floras in North America, namely the Channel Islands in Southern California (Murray and Littler 1981; Murray et al. 1980).

In the present study, we evaluate the floristic composition and affinities of seaweed populations from nine islands within the Penobscot Bay area of mid-coastal Maine, including contiguous nearshore Jericho Bay and offshore habitats (Table 1; Appendix). We compare these records with previous documentations of species composition from thirteen other islands, from the Bay of Fundy to southern Massachusetts (Figures 1–3; Table 2, 3). Data from 20 of these 22 islands represent our collections (Hehre et al. 1970; Mathieson and Penniman 1986b; Stone et al. 1970),

Table 1. Extended.

1986										1994			
5/29	5/30	6/1	6/2	6/5	6/6	6/7	6/8	6/9	6/12	7/15	7/16	7/17	7/18
		X											
X	X	X*							X				
			X		X	X							
										X**	X**	X**	X**
			X	X	X								
			X			X**	X						

made in accordance with a uniform protocol for collecting and identifying seaweeds, including the establishment of extensive voucher collections (Druehl 1981). Information for the other two islands (Kent Island, New Brunswick, and Penikese Island, Massachusetts) is based upon the work of others (Bowers 1942; Doty 1948; Koetzner and Wood 1972; Lewis 1924). In summary, the objectives of our study were four-fold as follows: (1) to assess the numbers and types of species from nine islands within the Penobscot Bay area of mid-coastal Maine (Appendix); (2) to evaluate the longevity pattern of seaweed populations from the Penobscot Bay area; (3) to compare the patterns of species richness among 22 individual islands, including nine from Penobscot Bay and thirteen other sites, from the Bay of Fundy, Canada, to Buzzards Bay, Massachusetts; and (4) to compare a "composite" of Penobscot Bay taxa from nine islands with thirteen other Northwest Atlantic islands.

MATERIALS AND METHODS

Collections of intertidal and shallow subtidal seaweeds were made at nine islands within the Penobscot Bay area (Figure 2, 3a, b). The selection of islands was based upon a variety of factors, including accessibility by boat, variation in size, degree of wave exposure, and proximity to other insular and nearshore environments. Four of the nine islands are located within Penobscot Bay proper (Hurricane, McGlathery, Two Bush, and Wooden

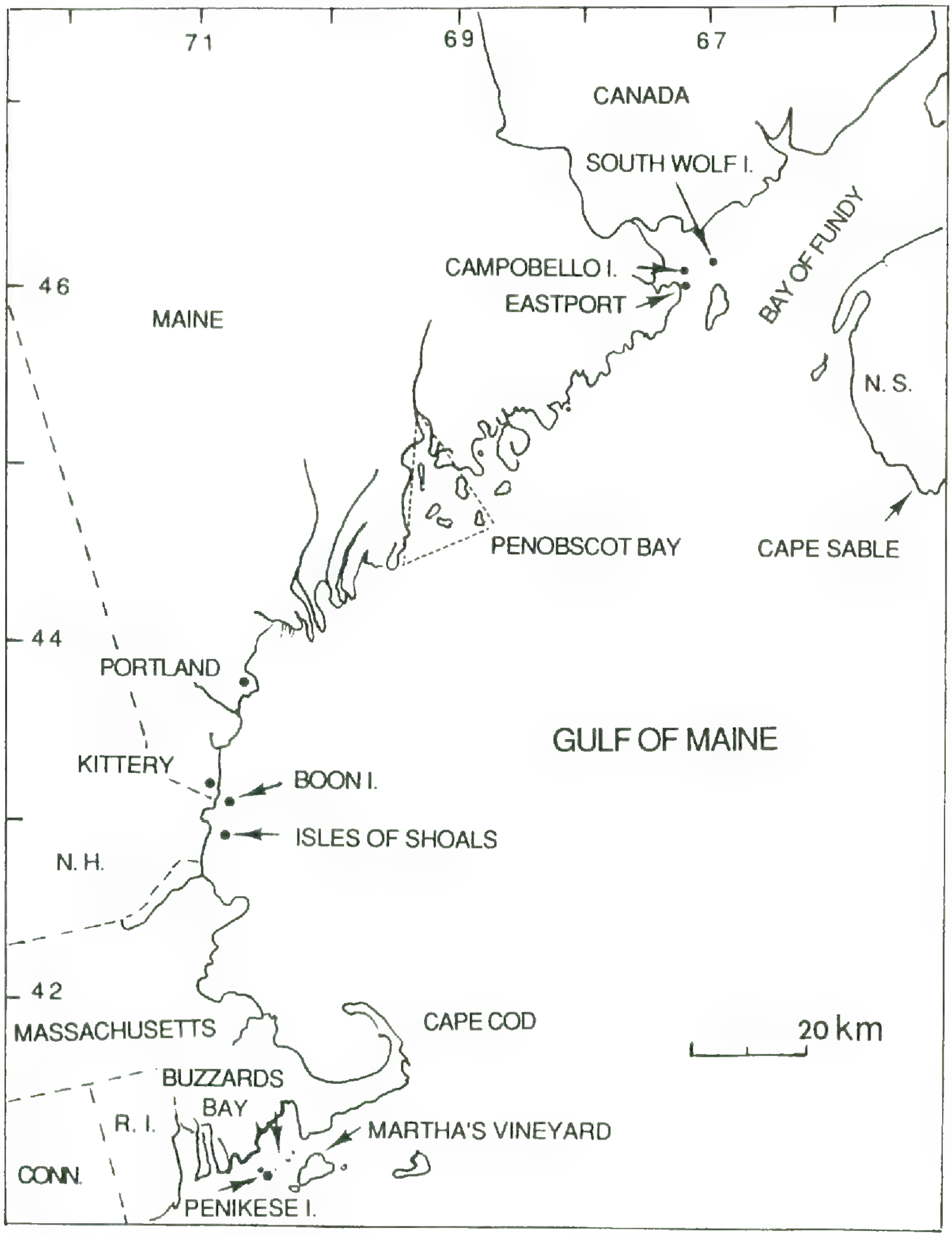


Figure 1. The northeastern coast of North America, from South Wolf Island, New Brunswick, Canada, to Buzzards Bay, Massachusetts, including the mid-coastal Penobscot Bay area of Maine.

Ball); three others (Long, Marshall, and Pond) occur within the contiguous Jericho Bay to the east (Figure 3b), and two (Allen and Monhegan) lie just W of Penobscot Bay proper (Figure 2, 3a). As noted by Conkling (1996), the seaward boundary for Penobscot Bay is somewhat vague but it is approximated by the 50

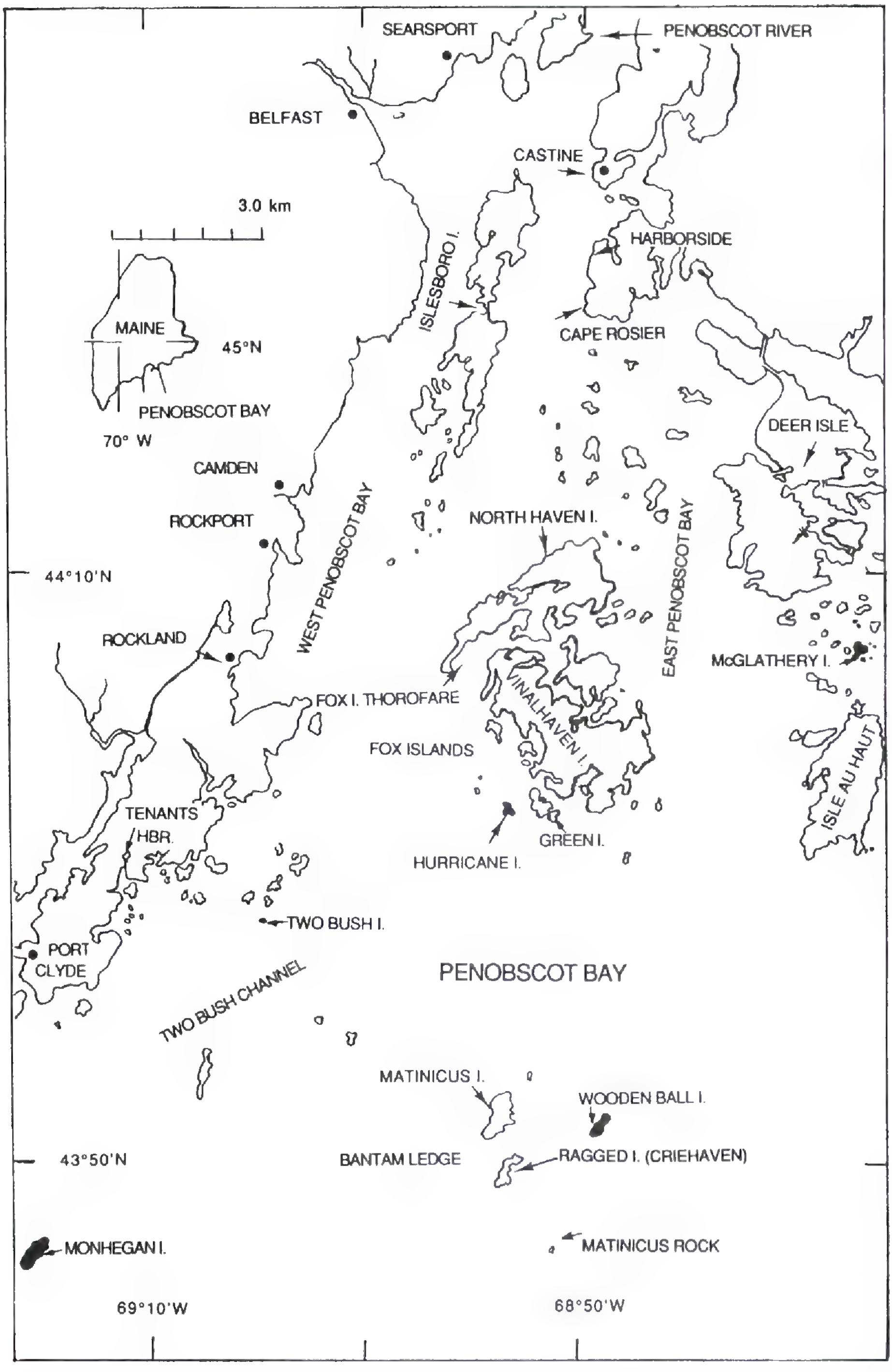
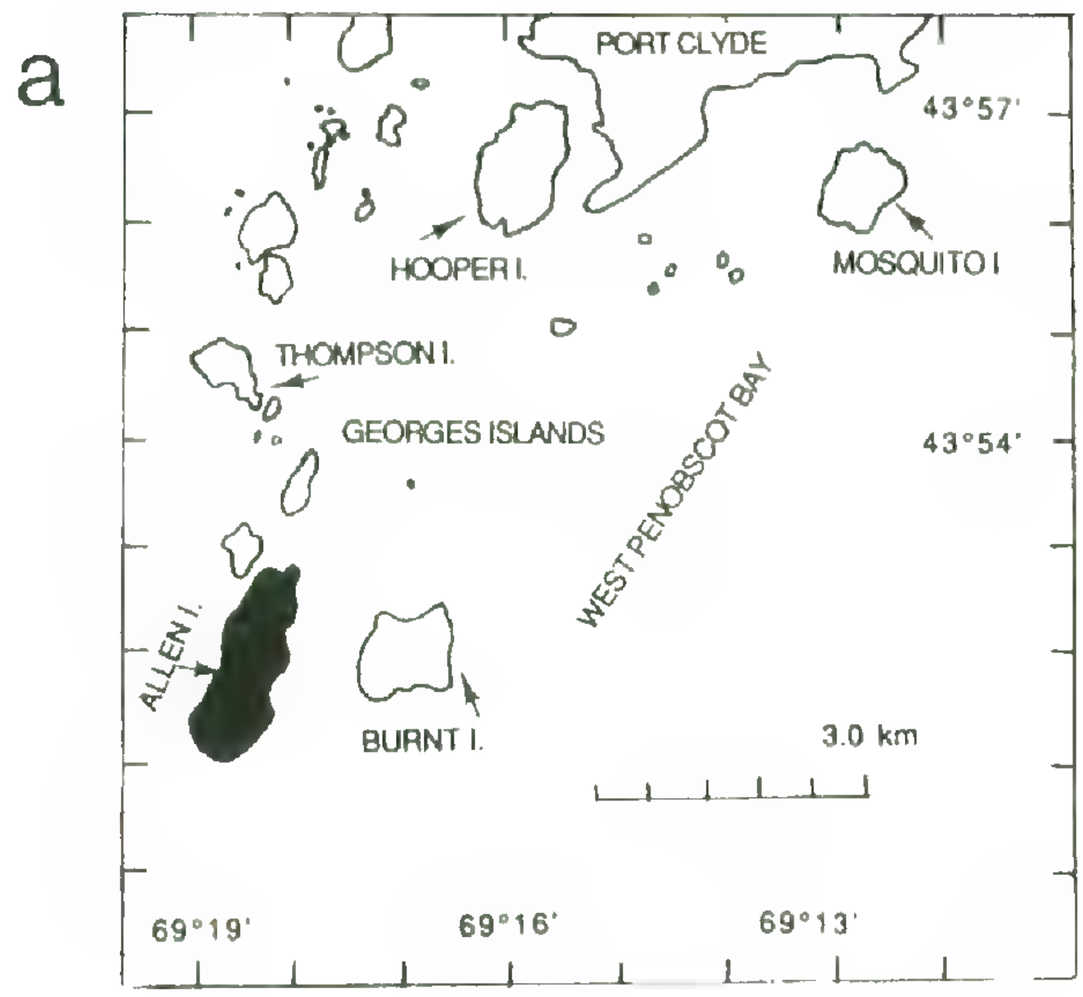


Figure 2. The mid-coastal Penobscot Bay area of Maine, showing the location of Monhegan, Hurricane, Two Bush, and Wooden Ball Islands.



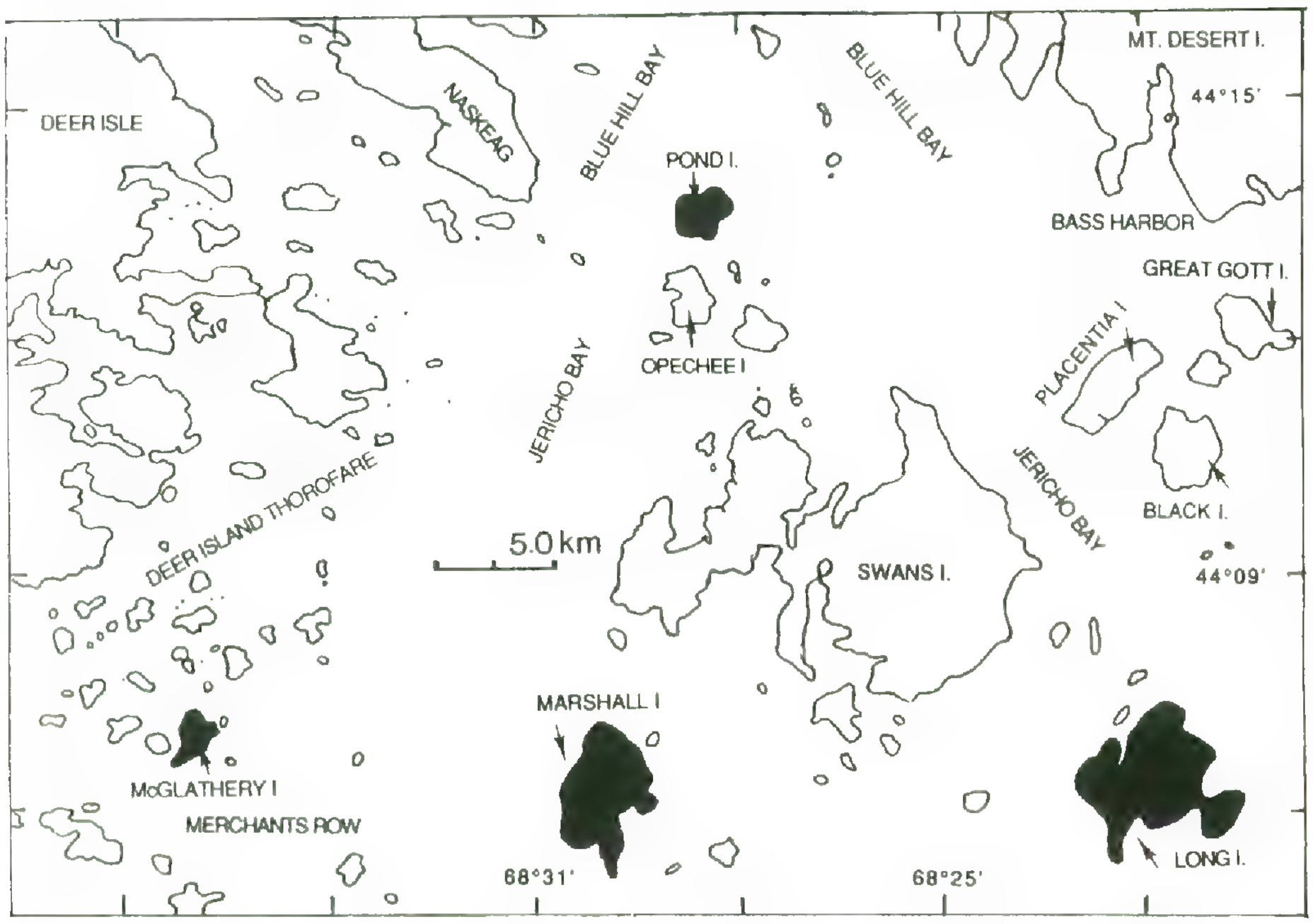


Figure 3. Penobscot Bay and contiguous Jericho Bay, Maine. a) West Penobscot Bay, showing Allen Island that is located south of Port Clyde; b) Eastern-most Penobscot Bay area, showing the locations of McGlathery Island near Deer Island Thorofare and three islands within contiguous Jericho Bay (Pond, Long, and Marshall).

fathom line near Matinicus Rock. As Monhegan lies just W of Matinicus Rock, we have chosen to include it within our study. Similarly, the other three islands (Long, Marshall, and Pond) are east of Penobscot Bay proper (Figure 3a, b).

Most of our Penobscot insular collections were made during the summers of 1985 and 1986, when one of us (JH) was working on Hurricane Island (Table 1). The notable exceptions are the collections made on Monhegan Island during the summer of 1994. Intertidal samples were collected on foot during low tides; subtidal collections were made by SCUBA diving to approximately 10–12m below mean low water (M.L.W.). Although an attempt was made to sample all conspicuous seaweeds on each island, limitations of boat time and diving personnel did not allow detailed subtidal sampling of all nine islands. Therefore, floristic documentations for individual islands should be considered preliminary; the "composite" for the Penobscot Bay area probably is more representative of the geography as a whole. The most detailed collections were made on Hurricane Island with six sampling dates (Table 1; Appendix), followed by Wooden Ball (4), Monhegan (4), Long (3), and Pond Islands (3); single collections were made on Allen, Marshall, McGlathery, and Two Bush Islands.

Seaweed samples either were pressed immediately or preserved in 2% formalin in seawater and stored in the dark. Several references were utilized for these identifications (Adey and Adey 1973; Bird and McLachlan 1992; Blair 1983; Bliding 1963, 1968; Burrows 1991; Dixon and Irvine 1977; Düwel and Wegeberg 1996; Farlow 1881; Fletcher 1987; Hoek 1963, 1982; Irvine 1983; Irvine and Chamberlain 1994; Kingsbury 1969; Maggs and Hommersand 1993; Schneider and Searles 1991; Taylor 1957; Villalard-Bohnsack 1995; Webber and Wilce 1971; Woelkerling 1973; Wynne and Heine 1992). Nomenclature primarily follows South and Tittley (1986), except for several recent changes noted above and in Villalard-Bohnsack (1995). Approximately 600 voucher specimens are deposited in the Albion R. Hodgdon Herbarium at the University of New Hampshire (NHA) documenting Penobscot Bay's insular flora.

In addition to our insular Penobscot Bay collections, we have made extensive collections at over 70 nearshore sites (Mathieson and Hehre, unpubl. data). The latter collections, which were made during 1993 to 1996, are utilized to characterize Penobscot Bay's total flora, in concert with several historical collections by F. S. Collins, W. G. Farlow, and J. Hooper during the last century. Many of Collins' and Farlow's specimens are deposited either at the New York Botanical Garden (NY) or the Farlow Herbarium

Table 2. Seaweed taxa from fourteen individual islands from the Bay of Fundy, Canada, to Buzzards Bay, Massachusetts, plus a "composite" of nine islands from the Penobscot Bay area of mid-coastal Maine. Key to symbols: X = a taxon's presence; % = percent occurrence at 13 individual islands and the "composite" value for nine Penobscot Bay islands — i.e., excluding Wooden Ball I. as an individual. The values in ( ) indicate the 14 individual islands — i.e., including Wooden Ball I. and excluding Penobscot Bay's "composite" value; " " = stage in the life history of another seaweed but recognizable as a distinct entity. Key to abbreviations: SW = South Wolf I., New Brunswick; CA = Campobello I., New Brunswick; KI = Kent I., New Brunswick; PB = a "composite" of nine islands from the Penobscot Bay area of Maine — i.e., Allen, Hurricane, Long, Marshall, McGlathery, Monhegan, Pond, Two Bush, and Wooden Ball Islands; WB = Wooden Ball I., Penobscot Bay, ME; BO = Boon I., ME; AP = Appledore I., ME (Isles of Shoals); CE = Cedar I., ME (Isles of Shoals); DU = Duck I., ME (Isles of Shoals); LU = Lunging I., NH (Isles of Shoals); MA = Malaga I., ME (Isles of Shoals); SM = Smuttynose I., ME (Isles of Shoals); ST = Star I., NH (Isles of Shoals); WH = White I., NH (Isles of Shoals); PI = Penikese I., Buzzards Bay, Mass.

	SW	CA	KI	PB	WB	BO	AP	CE	DU	LU	MA	SM	ST	WH	PI	%
Chlorophyta																
Acrochaete viridis (Reinke) R. Nielsen				X						X				X		21.4 (14.3)
Acrochaete wittrockii (Wille) R. Nielsen															X	7.1
Blidingia minima (Nägeli ex Kützing) Kylin	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	100
Bryopsis plumosa (Hudson) C. Agardh							X	X		X					X	28.6
Capsosiphon fulvescens (C. Agardh) Setchell et Gardner		X		X	X											14.3
Capsosiphon groenlandicum (J. Agardh) Vinogradova	X	X														14.3
Chaetomorpha aerea (Dillwyn) Kützing		X		X	X		X	X	X	X	X	X	X	X	X	78.6
Chaetomorpha brachygona Harvey									X					X		14.3
Chaetomorpha linum (O. F. Müller) Kützing				X			X	X	X	X	X	X	X	X	X	71.4 (64.3)
Chaetomorpha melagonium (Weber et Mohr) Kützing	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	100
Chaetomorpha minima Collins et Hervey												X				7.1

Table 2. Continued.

	SW	CA	KI	PB	WB	BO	AP	CE	DU	LU	MA	SM	ST	WH	PI	%
Chaetomorpha picquotiana Montagne ex Kützing				X	X			X	X	X	X	X	X	X		57.1
Chlorochytrium cohnii Wright				X	X											7.1
Cladophora albida (Nees) Kützing						X	X	X		X		X	X		X	50.0
Cladophora ruchingeri (J. Agardh) Kützing															X	7.1
Cladophora rupestris (L.) Kützing			X			X	X		X	X		X	X	X		57.1
Cladophora sericea (Hudson) Kützing		X	X	X	X	X	X	X	X	X	X	X	X	X	X	92.9
"*Codiolum gregarium* A. Braun"	X	X				X		X	X	X		X	X	X	X	71.4
"*Codiolum petrocelidis* Kuckuck"	X	X		X		X	X	X	X	X		X	X	X		78.6 (71.4)
"*Codiolum pusillum* (Lyngbye) Kjellman"	X	X				X		X	X	X		X	X	X		64.3
Codium fragile (Suringar) Har. ssp. *tomentosoides* (Goor) P. C. Silva							X		X	X	X	X			X	42.9
Derbesia marina (Lyngbye) Solier									X	X	X	X		X		35.7
Enteromorpha clathrata (Roth) Greville			X				X	X	X	X	X	X	X		X	64.3
Enteromorpha compressa (L.) Nees			X			X	X	X	X	X	X	X	X		X	71.4
Enteromorpha flexuosa (Wulfen ex Roth) J. Agardh ssp. *paradoxa* (Dillwyn) Bliding		X		X			X			X		X	X			42.9 (35.7)
Enteromorpha intestinalis (L.) Nees	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	100
Enteromorpha linza (L.) J. Agardh	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	100
Enteromorpha prolifera (O. F. Müller) J. Agardh		X	X	X	X	X	X	X	X	X	X	X	X		X	85.7
Epicladia flustrae Reinke	X	X								X						21.4
"*Gomontia polyrhiza* (Lagerheim) Bornet et Flahault"									X						X	14.3
Kornmannia leptoderma (Kjellman) Bliding	X	X														14.3

Table 2. Continued.

	SW	CA	KI	PB	WB	BO	AP	CE	DU	LU	MA	SM	ST	WH	PI	%
Monostroma grevillei (Thuret) Wittrock	X	X		X	X		X	X	X	X	X	X	X	X		78.6
Monostroma oxyspermum Kützing												X				7.1
Ochlochaete hystrix Thwaites ex Harvey															X	7.1
Percursaria percursa (C. Agardh) Bory		X					X		X				X			28.6
Prasiola stipitata Suhr in Jessen	X	X	X			X	X		X	X	X	X	X		X	78.6
Pringsheimiella scutata (Reinke) Hoehnel ex Marchewianka							X									7.1
Protomonostroma undulatum (Wittrock) Vinogr. f. *pulchrum* (Farlow) M. Wynne	X	X		X	X	X	X	X	X	X	X	X	X	X		85.7
Pseudendoclonium submarinum Wille	X	X		X	X				X						X	35.7
Rhizoclonium riparium (Roth) Kützing ex Harvey	X	X		X	X	X	X	X	X	X	X	X	X	X	X	92.9
Rhizoclonium tortuosum (Dillwyn) Kützing	X	X	X	X	X	X	X	X	X	X	X	X	X	X		92.9
Spongomorpha aeruginosa (L.) Hoek															X	7.1
Spongomorpha arcta (Dillwyn) Kützing	X	X	X	X	X		X	X	X	X	X	X	X	X	X	92.9
Spongomorpha spinescens Kützing	X	X	X	X	X	X	X	X	X	X	X	X	X	X		92.9
Stichococcus marinus (Wille) Hazen												X		X		14.3
Tellamia contorta Batters															X	7.1
Ulothrix flacca (Dillwyn) Thuret in Le Jolis		X	X	X	X		X	X	X	X	X	X	X	X	X	85.7
Ulothrix speciosa (Carmichael ex Harvey in Hooker) Kützing	X	X							X		X			X		35.7
Ulva lactuca L.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	100
Ulvaria obscura (Kützing) Gayral	X	X	X	X	X	X	X	X	X	X	X	X		X		85.7
Urospora penicilliformis (Roth) Areschoug	X	X		X	X	X	X	X	X	X	X	X	X	X	X	92.9
Urospora wormskjoldii (Mertens in Hornemann) Rosenvinge	X	X					X	X		X		X	X	X		57.1
Total Chlorophyta taxa = 52	23	30	17	25	21	20	30	27	33	34	25	34	29	28	27	

Table 2. Continued.

	SW	CA	KI	PB	WB	BO	AP	CE	DU	LU	MA	SM	ST	WH	PI	%
Phaeophyta																
Acrothrix gracilis Kylin															X	7.1
Agarum clathratum Dumort.	X	X	X	X		X	X	X	X	X	X	X	X	X		92.9 (85.7)
Alaria esculenta (L.) Greville	X	X	X	X	X	X	X	X	X			X	X	X		78.6
Ascocyclus distromaticus W. R. Taylor							X		X			X			X	28.6
Ascophyllum nodosum (L.) Le Jolis	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	100
Ascophyllum nodosum ecad *scorpioides* (Reinke) Hauck			X													7.1
Asperococcus fistulosus (Reinke) Hauck	X		X				X	X		X		X	X	X	X	64.3
Chorda filum (L.) Stackhouse		X					X					X			X	28.6
Chorda tomentosa Lyngbye	X	X		X		X	X					X	X			50.0 (42.9)
Chordaria flagelliformis (O. F. Müller) C. Agardh	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	100
Cladostephus spongiosus (Hudson) C. Agardh													X			7.1
Cladosiphon zosterae (J. Agardh) Kylin						X									X	14.3
Delamarea attenuata (Kjellman) Rosenvinge															X	7.1
Desmarestia aculeata (L.) Lamouroux	X	X	X			X	X	X		X	X	X		X	X	78.6
Desmarestia viridis (O. F. Müller) Lamouroux		X	X			X	X	X	X	X	X	X	X	X	X	85.7
Dictyosiphon foeniculaceus (Hudson) Greville	X	X	X	X	X	X	X	X	X	X	X	X	X		X	92.9
Dictyosiphon macounii Farlow		X														7.1
Ectocarpus fasciculatus Harvey		X		X	X							X	X		X	35.7
Ectocarpus siliculosus (Dillwyn) Lyngbye	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	100
Elachista fucicola (Velley) Areschoug	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	100

Table 2. Continued.

	SW	CA	KI	PB	WB	BO	AP	CE	DU	LU	MA	SM	ST	WH	PI	%
Eudesme virescens (Carmichael ex Harvey in Hooker) J. Agardh						X									X	14.3
Fucus distichus L. emend. Powell ssp. *anceps* (Harvey et Ward ex Carruther) Powell							X	X	X	X		X	X	X		50.0
Fucus distichus L. emend. Powell ssp. *distichus* Powell	X	X	X	X	X	X	X	X		X		X	X	X		78.6
Fucus distichus L. ssp. *edentatus* (Bach. Pyl.) Powell	X	X	X	X	X	X	X	X	X	X	X	X	X	X		92.9
Fucus distichus L. ssp. *evanescens* (C. Agardh) Powell	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	100
Fucus spiralis L.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	100
Fucus vesiculosus L.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	100
Hincksia granulosa (J. E. Smith) P. C. Silva in P. C. Silva			X			X	X									21.4
Hincksia ovata (Kjellman) P. C. Silva															X	7.1
Isthmoplea sphaerophora (Carmichael ex Harvey in Hooker) Kjellman	X	X		X	X		X	X								35.7
Laminaria digitata (Hudson) Lamouroux	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	100
Laminaria longicruris Bach. Pyl.	X	X	X				X		X				X		X	50.0
Laminaria saccharina (L.) Lamouroux	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	100
Laminariocolax tomentosoides (Farlow) Kylin												X				7.1
Leathesia difformis (L.) Areschoug	X	X		X		X	X	X	X	X	X	X	X	X	X	92.9 (85.7)
Melanosiphon intestinalis (Saunders) M. Wynne				X		X						X		X		28.6 (21.4)
Microspongium globosum Reinke															X	7.1
Mikrosyphar porphyrae Kuckuck							X		X			X	X			28.6
Myrionema balticum (Reinke) Foslie															X	7.1

Table 2. Continued.

	SW	CA	KI	PB	WB	BO	AP	CE	DU	LU	MA	SM	ST	WH	PI	%
Myrionema corunnae Sauvageau				X		X	X	X	X	X	X			X		57.1 (50.0)
Myrionema strangulans Greville	X	X		X		X	X			X		X			X	57.1 (50.0)
Myriotrichia clavaeformis Harvey															X	7.1
Petalonia fascia (O. F. Müller) Kuntze	X	X		X	X	X	X	X	X	X	X	X	X	X	X	92.9
Petalonia zosterifolia (Reinke) Kuntze												X	X			14.3
Petroderma maculiforme (Wollny) Kuckuck				X	X											7.1
Pilayella littoralis (L.) Kjellman	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	100
Protectocarpus speciosus (Børgesen) Kuckuck		X					X			X	X	X	X	X		50.0
Pseudolithoderma extensum (P. Crouan et H. Crouan) S. Lund				X	X			X	X	X						28.6
Punctaria latifolia Greville		X	X	X	X										X	21.4
Punctaria plantaginea (Roth) Greville				X		X	X	X		X		X			X	50.0 (42.9)
Punctaria tenuissima (C. Agardh) Greville								X						X	X	21.4
"*Ralfsia bornetii* Kuckuck"		X							X		X	X	X	X		42.9
"*Ralfsia clavata* (Carmichael) Crouan *sensu* Farlow"		X		X					X		X	X	X	X		50.0 (42.9)
Ralfsia fungiformis (Gunnerus) Setchell et Gardner	X	X	X													21.4
Ralfsia verrucosa (Areschoug) J. Agardh		X		X		X	X	X	X	X	X	X	X		X	78.6 (71.4)
Saccorhiza dermatodea (Bach. Pyl.) J. Agardh		X		X		X	X	X				X				42.9 (35.7)
Sargassum filipendula C. Agardh															X	7.1
Scytosiphon simplicissimus (Clemente) Cremades	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	100
Sphacelaria cirrosa (Roth) C. Agardh	X	X		X	X		X	X	X	X	X	X	X	X	X	85.7
Sphacelaria fusca (Hudson) S. F. Gray												X				7.1

Table 2. Continued.

	SW	CA	KI	PB	WB	BO	AP	CE	DU	LU	MA	SM	ST	WH	PI	%
Sphaerotrichia divaricata (C. Agardh) Kylin			X	X	X											21.4 (14.3)
Spongonema tomentosum (Hudson) Kützing		X				X	X		X	X				X	X	50.0
Ulonema rhizophorum Foslie				X			X	X		X	X	X	X	X		57.1 (50.0)
Total Phaeophyta taxa = 63	26	37	25	34	23	31	38	31	29	30	25	40	33	30	37	
Rhodophyta																
Agardhiella subulata (J. Agardh) Kraft et M. Wynne															X	7.1
Aglaothamnion westbrookiae Rueness et L'Hardy-Halos							X								X	14.3
Ahnfeltia plicata (Hudson) Fries	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	100
Antithamnion cruciatum (C. Agardh) Nägeli															X	7.1
Antithamnionella floccosa (O. F. Müller) Whittick	X	X		X			X	X	X	X	X	X	X	X		78.6 (71.4)
Audouinella alariae (Jónsson) Woelkerling	X			X		X		X		X		X	X			50.0 (42.9)
Audouinella dasyae (Collins) Woelkerling															X	7.1
Audouinella daviesii (Dillwyn) Woelkerling			X?												X	14.3
Audouinella membranacea (Magnus) Papenfuss	X	X							X							21.4
Audouinella microscopica (Nägeli in Kützing) Woelkerling															X	7.1
Audouinella purpurea (Lightfoot) Woelkerling	X	X		X	X	X	X	X	X	X	X	X	X	X		85.7
Audouinella saviana (Meneghini) Woelkerling															X	7.1

Table 2. Continued.

	SW	CA	KI	PB	WB	BO	AP	CE	DU	LU	MA	SM	ST	WH	PI	%
Audouinella secundata (Lyngbye) P. Dixon in M. Parke et P. Dixon	X	X	X	X	X		X					X		X	X	57.1
Bangia atropurpurea (Roth) C. Agardh	X	X		X	X			X			X	X	X	X	X	64.3
Bonnemaisonia hamifera Hariot						X	X	X	X	X	X	X		X	X	64.3
Callithamnion corymbosum (J. E. Smith) Lyngbye															X	7.1
Callithamnion tetragonum (Withering) S. F. Gray				X		X	X	X	X	X	X	X	X	X	X	78.6 (71.4)
Callocolax neglectus Schmitz ex Batters							X	X		X		X	X	X		42.9
Callophyllis cristata (C. Agardh) Kützing	X	X	X			X	X	X	X	X	X	X	X	X		85.7
Ceramium cimbricum H. E. Petersen in Rosenvinge															X	7.1
Ceramium deslongchampii Chauvin ex Duby	X	X		X	X	X	X	X	X	X	X	X	X	X	X	92.7
Ceramium diaphanum (Lightfoot) Roth															X	7.1
Ceramium nodulosum (Lightf.) Ducluzeau	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	100
Ceramium strictum Harvey															X	7.1
Ceratocolax hartzii Rosenvinge							X	X		X		X				28.6
Champia parvula (C. Agardh) Harvey															X	7.1
Chondria baileyana (Mont.) Harvey															X	7.1
Chondria capillaris (Hudson) M. Wynne															X	7.1
Chondria sedifolia Harvey															X	7.1
Chondrus crispus Stackhouse	X	X		X	X	X	X	X	X	X	X	X	X	X	X	92.9
Choreocolax polysiphoniae Reinsch	X	X		X		X		X	X	X		X	X		X	71.4 (64.3)
Clathromorphum circumscriptum (Strömfelt) Foslie	X	X		X	X	X	X	X	X	X	X	X	X	X		85.7
Coccotylus truncatus (Pallas) M. Wynne et Heine			X			X	X	X	X	X	X	X	X	X	X	78.6

Table 2. Continued.

	SW	CA	KI	PB	WB	BO	AP	CE	DU	LU	MA	SM	ST	WH	PI	%
Corallina officinalis L.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	100
Cystoclonium purpureum (Hudson) Batters	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	100
Dasya baillouviana (S. Gmelin) Montagne															X	7.1
Devaleraea ramentacea (L.) Guiry	X	X	X	X	X	X	X	X		X	X	X	X	X		85.7
Dumontia contorta (S. Gmelin) Ruprecht		X	X	X		X	X	X	X	X	X	X	X	X	X	92.9 (85.7)
Erythrodermis traillii (Holmes ex Batters) Guiry et Garbary						X	X		X	X		X		X		42.9
Erythrotrichia carnea (Dillwyn) J. Agardh							X	X		X	X	X			X	42.9
Erythrotrichopeltis ciliaris (Carmichael ex Harvey in Hooker) Kornmann							X	X	X	X	X		X	X		50.0
Fimbrifolium dichotomum (Lepechkin) Hansen							X					X				14.3
Gloiosiphonia capillaris (Hudson) Carmichael ex Berkeley				X		X	X		X			X				35.7 (28.6)
Griffithsia globulifera Harvey ex Kütz.															X	7.1
Grinnellia americana (C. Agardh) Harvey															X	7.1
Gymnogongrus crenulatus (Turner) J. Agardh							X	X	X	X	X	X	X	X		57.1
Halosacciocolax kjellmanii Lund												X				7.1
Harveyella mirabilis (Reinsch) F. Schmitz et Reinke							X			X			X			21.4
Hildenbrandia rubra (Sommerfelt) Meneghini	X	X	X	X	X			X	X	X	X	X	X		X	78.6
Lithothamnion glaciale Kjellman	X	X		X	X	X	X	X	X	X	X	X	X	X	X	92.9
Lomentaria baileyana (Harvey) Farlow															X	7.1
Lomentaria clavellosa (Turner) Gaillon						X										7.1
Lomentaria orcadensis (Harvey) Collins ex W. R. Taylor								X		X		X				21.4

Table 2. Continued.

	SW	CA	KI	PB	WB	BO	AP	CE	DU	LU	MA	SM	ST	WH	PI	%
Mastocarpus stellatus (Stackhouse in Withering) Guiry in Guiry et al.	X	X	X	X	X		X	X	X	X	X	X	X	X		85.7
Membranoptera alata (Hudson) Stackhouse	X	X				X	X	X	X	X		X	X	X		71.4
Nemalion helminthoides (Velley in Withering) Batters						X	X					X	X		X	35.7
Palmaria palmata (L.) Kuntze	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	100
Pantoneura baerii (Postels et Ruprecht) Kylin							X									7.1
"*Petrocelis cruenta* J. Agardh"	X	X		X		X	X	X	X	X	X	X	X	X		85.7 (78.6)
Peyssonnelia rosenvingii Schmitz in Rosenvinge	X	X									X	X				28.6
Phycodrys rubens (L.) Batters	X	X	X	X		X	X	X	X	X	X	X	X	X	X	100 (92.9)
Phyllophora pseudoceranoides (Gmelin) Newroth et A. Taylor				X		X	X	X	X	X		X	X	X	X	71.4 (64.3)
Phymatolithon foecundum (Kjellman) Düwel et Wegeberg						X		X	X	X		X	X	X		50.0
Phymatolithon laevigatum (Foslie) Foslie						X		X	X	X	X	X				42.9
Phymatolithon lenormandii (Areschoug in J. Agardh) Adey	X			X		X	X	X	X	X	X	X	X	X	X	85.7 (78.6)
Phymatolithon polymorphum (L.) Foslie															X?	7.1
Phymatolithon rugulosum Adey											X	X				14.3
Phymatolithon tenue (Rosenvinge) Düwel et Wegeberg						X	X	X	X	X	X	X		X		57.1
Pleonosporium borreri (J. E. Smith) Nägeli ex Hauck															X	7.1
Plumaria plumosa (Hudson) Kuntze	X	X		X	X	X	X	X	X	X	X	X	X	X	X	92.9
Pneophyllum fragile Kützing							X	X	X	X		X	X	X	X	57.1

Table 2. Continued.

	SW	CA	KI	PB	WB	BO	AP	CE	DU	LU	MA	SM	ST	WH	PI	%
Polyides rotundus (Hudson) Greville	X	X						X	X	X	X	X	X	X	X	71.4
Polysiphonia denudata (Dillwyn) Greville ex Harvey in Hooker															X	7.1
Polysiphonia elongata (Hudson) Sprengel															X	7.1
Polysiphonia fibrillosa (Dillwyn) Sprengel															X	7.1
Polysiphonia flexicaulis (Harvey) Collins		X		X		X	X	X	X		X	X	X	X	X	78.6 (71.4)
Polysiphonia fucoides (Hudson) Greville		X	X			X	X	X	X	X	X	X	X	X	X	85.7
Polysiphonia harveyi J. Bailey			X	X		X	X	X	X	X	X	X	X	X	X	85.7 (78.6)
Polysiphonia lanosa (L.) Tandy	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	100
Polysiphonia nigra (Hudson) Batters													X		X	14.3
Polysiphonia stricta (Dillwyn) Greville	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	100
Polysiphonia subtilissima Montagne															X	7.1
Porphyra amplissima (Kjellman) Setchell et Hus	X	X		X		X	X					X				42.9 (35.7)
Porphyra leucosticta Thuret in Le Jolis	X						X	X	X	X	X	X	X	X		64.3
Porphyra linearis Greville	X											X	X			21.4
Porphyra miniata (C. Agardh) C. Agardh		X		X		X	X		X			X	X	X		57.1 (50.0)
Porphyra umbilicalis (L.) J. Agardh	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	100
Pterothamnion plumula (Ellis) Nägeli								X				X			X	21.4
Ptilota serrata Kützing	X	X	X			X	X	X	X	X	X	X	X	X	X	92.9
Rhodomela confervoides (Hudson) Silva	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	100
Rhodophysema elegans (P. Crouan et H. Crouan ex J. Agardh) P. Dixon				X	X					X	X		X			28.6
Rhodophysema georgii Batters		X													X	14.3
Scagelia pylaisaei (Mont.) M. Wynne	X	X		X		X	X	X	X			X	X	X	X	78.6 (71.4)
Scinaia forcellata Bivona															X	7.1
Seirospora interrupta (J. E. Smith) F. Schmitz															X	7.1

Table 2. Continued.

	SW	CA	KI	PB	WB	BO	AP	CE	DU	LU	MA	SM	ST	WH	PI	%
Spermothamnion repens (Dillwyn) Rosenvinge		X					X								X	23.1
Spyridia filamentosa (Wulfen) Harvey in Hooker															X	7.1
Stylonema alsidii (Zanardini) Drew								X		X	X					21.4
Titanoderma corallinae (P. Crouan et H. Crouan) Woelkerling, Chamberlain et Silva		X		X			X	X	X	X				X		50.0 (42.9)
Titanoderma pustulatum (Lamouroux) Woelkerling, Chamberlain et Silva		X				X	X	X	X	X	X	X	X	X	X	78.6
"*Trailliella intricata* Batters"				X			X	X				X	X	X	X	50.0 (42.9)
Total Rhodophyta taxa = 101	36	40	21	38	21	43	55	54	48	52	44	62	51	48	67	
Grand total seaweed taxa = 216	85	107	63	97	65	94	123	112	110	116	94	136	113	106	131	

Table 3. Summary of seaweed taxa from nine islands within the Penobscot Bay area of mid-coastal Maine. Key to symbols: X = a taxon's presence; % = percent occurrence based upon all nine islands. Key to abbreviations: Islands: A I = Allen I.; H I = Hurricane I.; L I = Long I.; M I = Marshall I.; Mc I = McGlathery I.; MO I = Monhegan I.; P I = Pond I.; TB I = Two Bush I.; WB I = Wooden Ball I. Longevity: Ann. = seasonal annual; AAnn = aseasonal annual; Per. = perennial; PPer. = pseudoperennial.

	A I	H I	L I	M I	Mc I
Chlorophyta					
Acrochaete viridis					
Blidingia minima					
Capsosiphon fulvescens					
Chaetomorpha aerea					
Chaetomorpha linum					
Chaetomorpha melagonium		X	X	X	
Chaetomorpha picquotiana					
Chlorochytrium cohnii					
Cladophora sericea				X	
"*Codiolum petrocelidis*"					
Enteromorpha flexuosa ssp. *paradoxa*					
Enteromorpha intestinalis					
Enteromorpha linza		X			
Enteromorpha prolifera		X			
Monostroma grevillei					
Protomonostroma undulatum f. *pulchrum*		X	X	X	
Pseudendoclonium submarinum					
Rhizoclonium riparium					
Rhizoclonium tortuosum		X	X		X
Spongomorpha arcta		X			
Spongomorpha spinescens		X	X		X
Ulothrix flacca			X		
Ulva lactuca		X	X	X	X
Ulvaria obscura		X	X	X	
Urospora penicilliformis			X		
Total Chlorophyta taxa = 25	0	9	8	5	3
Phaeophyta					
Agarum clathratum		X	X	X	
Alaria esculenta		X	X		
Ascophyllum nodosum	X	X	X	X	
Chorda tomentosa		X	X		X
Chordaria flagelliformis					X
Dictyosiphon foeniculaceus		X	X		
Ectocarpus fasciculatus					
Ectocarpus siliculosus		X			

Table 3. Extended.

MO I	P I	TB I	WB I	Longevity	%
X				AAnn.	11.1
X			X	AAnn.	22.2
			X	Ann.	11.1
			X	Per.	11.1
X				Per.	11.1
X			X	Per.	55.6
X			X	Per.	22.2
			X	Ann.	11.1
X			X	PPer.	33.3
X				Ann.?	11.1
X				Ann.	11.1
X			X	AAnn.	22.2
			X	AAnn.	22.2
			X	AAnn.	22.2
			X	Ann.	11.1
			X	Ann.	44.4
			X	AAnn.	11.1
			X	AAnn.	11.1
X	X	X	X	AAnn.?	77.8
X			X	Ann.	33.3
X			X	Ann.	55.5
			X	Ann.	22.2
X			X	PPer.	66.7
X			X	Ann.	55.6
			X	Ann.	22.2
14	1	1	21		
				Per.	33.3
X			X	Per.	44.4
X	X		X	Per.	77.8
				Ann.	33.3
X			X	Ann.	33.3
X			X	Ann.	44.4
			X	Ann.	11.1
X			X	Ann.	33.3

Table 3. Continued.

	A I	H I	L I	M I	Mc I
Phaeophyta					
Elachista fucicola	X	X	X	X	X
Fucus distichus ssp. *distichus*					
Fucus distichus ssp. *edentatus*		X	X		
Fucus distichus ssp. *evanescens*		X	X		
Fucus spiralis					
Fucus vesiculosus		X	X	X	X
Isthmoplea sphaerophora					
Laminaria digitata		X	X	X	
Laminaria saccharina		X		X	
Leathesia difformis					
Melanosiphon intestinalis				X	
Myrionema corunnae					
Myrionema strangulans					
Petalonia fascia		X	X		
Petroderma maculiforme					
Pilayella littoralis	X	X	X	X	X
Pseudolithoderma extensum					
Punctaria latifolia					
Punctaria plantaginea		X			
"*Ralfsia clavata*"					
Ralfsia verrucosa					
Saccorhiza dermatodea		X			
Scytosiphon simplicissimus		X	X		
Sphacelaria cirrosa					
Sphaerotrichia divaricata		X	X		
Ulonema rhizophorum					
Total Phaeophyta taxa = 34	3	18	14	8	5
Rhodophyta					
Ahnfeltia plicata				X	
Antithamnionella floccosa			X		
Audouinella alariae					
Audouinella purpurea					
Audouinella secundata					
Bangia atropurpurea			X		
Callithamnion tetragonum		X			
Ceramium deslongchampii					
Ceramium nodulosum		X	X	X	X
Chondrus crispus		X	X	X	X
Choreocolax polysiphoniae		X		X	
Clathromorphum circumscriptum					X
Corallina officinalis		X	X	X	X
Cystoclonium purpureum		X		X	
Devaleraea ramentacea		X	X		

Table 3. Extended, Continued.

MO I	P I	TB I	WB I	Longevity	%
X	X	X	X	Per.	100
			X	Per.	11.1
X			X	Per.	44.4
X			X	Per.	44.4
X			X	Per.	22.2
X	X	X	X	Per.	88.9
X			X	Ann.	22.2
X			X	Per.	55.6
X			X	Per.	44.4
X				Ann.	11.1
				Ann.	11.1
X				Ann.	11.1
X				Ann.	11.1
X		X	X	Ann.	55.6
			X	Per.	11.1
X	X	X	X	Ann.	100
			X	Per.	11.1
			X	Ann.	11.1
				Ann.	11.1
X				Per.?	11.1
	X			Per.	11.1
				Ann.	11.1
X	X		X	Ann.	55.6
			X	Per.	11.1
			X	Ann.	33.3
X	X			Ann.	22.2
21	7	4	23		
X			X	Per.	33.3
X				AAnn.	22.2
X				Ann.	11.1
			X	Per.	11.1
X			X	AAnn.	22.2
			X	Ann.	22.2
	X			Per.	22.2
X			X	Per.?	22.2
X			X	Per.	66.7
X	X	X	X	Per.	88.9
X				Per.	33.3
X			X	Per.	33.3
X			X	Per.	66.7
X			X	Per.	44.4
X			X	Per.	44.4

Table 3. Continued.

	A I	H I	L I	M I	Mc I
Rhodophyta					
Dumontia contorta		X	X	X	X
Gloiosiphonia capillaris		X			
Hildenbrandia rubra					
Lithothamnion glaciale					
Mastocarpus stellatus		X	X		X
Palmaria palmata		X	X		X
"Petrocelis cruenta"					
Phycodrys rubens					
Phyllophora pseudoceranoides					
Phymatolithon lenormandii					
Plumaria plumosa					
Polysiphonia flexicaulis		X			
Polysiphonia harveyi					
Polysiphonia lanosa	X	X	X	X	
Polysiphonia stricta		X	X		
Porphyra amplissima		X			
Porphyra miniata				X	X
Porphyra umbilicalis		X	X	X	
Rhodomela confervoides		X	X		
Rhodophysema elegans					
Scagelia pylaisei		X	X		
Titanoderma corallinae				X	
"Trailliella intricata"					
Total Rhodophyta taxa = 38	1	18	14	11	8
Grand total seaweed taxa = 97	4	45	36	24	16
Total no. annual taxa	1	21	17	7	3
Total no. perennial taxa	3	24	19	17	16
Longevity ratio (annual/perennial taxa)	0.33	0.88	0.90	0.41	0.19
% Annual taxa	25.0	47.0	47.2	29.2	18.8
% Perennial taxa	75.0	53.0	52.8	70.8	81.2

of Harvard University (FH). Most of Hooper's collections are in the Herbarium at the Brooklyn Botanic Garden (BKL), with a few occurring at the University of New Hampshire (NHA). An examination of all Penobscot Bay specimens from each of these historical collections was made and pertinent details are discussed in a later section.

Specific information regarding the locations and shoreline di-

Table 3. Extended, Continued.

MO I	P I	TB I	WB I	Longevity	%
X	X	X		Ann.	77.8
				Ann.	11.1
	X		X	Per.	22.2
X			X	Per.	22.2
X		X	X	Per.	66.7
X		X	X	Per.	66.7
X				Per.	11.1
X				Per.	11.1
X				Per.	11.1
X				Per.	11.1
X				Per.	11.1
X			X	Per.	22.2
X				Per.	22.2
X				Ann.	11.1
X	X		X	Per.	77.8
X			X	Per.	44.4
		X		Ann.	22.2
				Ann.	22.2
X			X	Ann.	55.6
X			X	Per.	44.4
			X	Per.	11.1
				AAnn.	22.2
X				Per.	22.2
X				Per.	11.1
29	5	5	21		
64	13	10	65		
26	5	5	29	(Mean = 12.7 ± 10.7)	
38	8	5	36	(Mean = 18.4 ± 12.5)	
0.68	0.63	1.0	0.81	(Mean = 0.65 ± 0.28)	
40.6	38.5	50.0	44.6	(Mean = 37.9 ± 11.0)	
59.4	61.5	50.0	55.4	(Mean = 62.1 ± 11.0)	

mensions (at high tide) of the nine Penobscot Bay islands (Allen, Hurricane, Long, Marshall, McGlathery, Monhegan, Pond, Two Bush, and Wooden Ball) is given in the Appendix. The latter values were enumerated by tracing each island's outline with a piece of thread on a National Oceanic Survey chart and converting it via the map's scalar (Mathieson and Penniman 1986b). As noted previously, thirteen other islands from the Bay of Fundy to

southern Massachusetts also were compared (Table 2). Detailed characterizations of nine of these islands (Appledore, Cedar, Duck, Lunging, Malaga, Smuttynose, Star, and White within the Isles of Shoals, plus Boon) are given by Mathieson and Penniman (1986b). Hehre et al. (1970) and Stone et al. (1970) describe South Wolf and Campobello Islands, New Brunswick; Doty (1948) and Lewis (1924) characterize Penikese Island (Buzzards Bay, Massachusetts); Koetzner and Wood (1972) describe Kent Island, New Brunswick, at the mouth of the Bay of Fundy.

Two comparisons of the Penobscot Bay floras and the thirteen other Northwest Atlantic sites are given here (Tables 2–4). A "composite" of the nine islands from the Penobscot area is used in one comparison, due to limited seasonal and subtidal collections of individual islands (Table 1); a comparison with Wooden Ball Island, which shows the most diverse flora within Penobscot Bay, also is given. The number and percentage of taxa in common to these different sites are presented (Table 4), with the percent similarity (C) determined using Czekanowski's coefficient (Bray and Curtis 1957):

$$C = \frac{2w}{a + b}$$

where "w" = the number of taxa in common to both sites, "a" = the number of taxa at one site, and "b" = the number of taxa at the second site.

Longevity characteristics of all seaweed taxa from the Penobscot Bay area are enumerated according to the scheme outlined by Knight and Parke (1931). The different taxa are designated as annuals (aseasonal or seasonal), perennials, or pseudoperennials, depending upon their life span, growth, and reproductive characteristics (Mathieson 1989). Longevity delineations are based on a number of field studies throughout New England (Coleman and Mathieson 1975; Hehre and Mathieson 1970; Hehre et al. 1970; Mathieson and Hehre 1982, 1983, 1986; Mathieson et al. 1993; Mathieson, Hehre, and Reynolds 1981; Mathieson and Penniman 1991; Mathieson, Reynolds, and Hehre 1981; Reynolds and Mathieson 1975; Sears and Wilce 1975; Stone et al. 1970).

Habitat description. Penobscot Bay (Figure 1) is the second largest embayment on the Atlantic Coast of the United States (Platt et al. 1996) and the largest within Maine (Apollonio 1979;

Conkling 1996; Doyle et al. 1970; Platt 1996; Porter 1966; Rich 1975). The Bay is located approximately 43 km northeast of Portland. It extends northward nearly 38 km from the edge of the Gulf of Maine to the mouth of the Penobscot River (near Searsport), encompassing hundreds of insular habitats (Figure 2, 3). In plan view, Penobscot Bay is triangular in shape, with its apex being near the mouth of the Penobscot River at Searsport and its base stretching about 19 km east-west between Port Clyde and Isle Au Haut (offshore of these sites). As noted by Conkling (1996), the precise delineation as to where the Bay ends and the Gulf of Maine begins is somewhat arbitrary, but a physical oceanographic boundary of sorts is the 50 fathom line that is just seaward of Matinicus Rock. Overall, the Bay embraces about 186 km^2 and has an irregular perimeter of 93 km (Doyle et al. 1970). Approximately twenty percent of the total river water entering the Gulf of Maine passes through the Penobscot watershed, which originates some 200 miles inland from the mouth of the Penobscot River (Platt et al. 1996).

Historically, the Penobscot Bay occupied the lower channel of a preglacial river (the Penobscot River), which flowed out onto the continental shelf at a time when sea levels were considerably lower than today. A rise in sea level since the retreat of the Wisconsin ice sheet (approximately 10,000 years ago) drowned the ancestral valley to form the Penobscot Bay and estuary (Kelly 1992). Because submergence affected the land surface which was modified by glacial activity, the Bay should be classified as a fjord-type habitat. The coastline displays a narrow, glacially scoured channel, a relatively uniform nearshore bottom, and a seaward shelf.

As noted by Collins (1899), the Penobscot Bay area is seldom exposed to the open sea. It is guarded by a thick fringe of both large and small islands, which provides a variety of sheltered habitats; only the outer islands are exposed to heavy seas. Overall, there are hundreds of islands and seven major harbors (Belfast, Camden, Castine, Deer Isle Harbor, Rockland, Rockport, and Searsport) within the Bay (Figure 2, 3). The two largest islands are Vinalhaven and Deer Isle, which are in the central and northeastern portions, respectively. The Fox Islands (Green, Hurricane, North Haven, and Vinalhaven, plus many smaller ones) cover an area of 6.2–7.4 km^2. The islands were so named by an explorer in 1603 who was intrigued by the number of silver-gray foxes

Table 4. Floristic affinities of fourteen individual islands from the Bay of Fundy, Canada, to Buzzards Bay, Masssachusetts, plus a "composite" of nine islands from the Penobscot Bay area of mid-coastal Maine, expressed as the number and % of shared taxa/location. Key to abbreviations: see Table 2.

	SW	CA	KI	PB
South Wolf	85			
	100%			
Campobello	80	107		
	83%	100%		
Kent	42	52	63	
	57%	61%	100%	
Penobscot Bay "composite"	64	78	47	97
	70%	76%	59%	100%
Wooden Ball	52	59	42	65
	69%	69%	66%	80%
Boon	62	73	47	68
	69%	73%	60%	71%
Appledore	66	85	57	80
	63%	74%	61%	73%
Cedar	70	78	53	78
	71%	71%	61%	75%
Duck	67	80	52	73
	69%	74%	60%	71%
Lunging	69	77	53	76
	69%	71%	59%	71%
Malaga	61	73	50	68
	68%	73%	64%	84%
Smuttynose	76	89	55	85
	69%	73%	55%	73%
Star	71	83	51	78
	72%	76%	58%	74%
White	67	78	49	75
	70%	73%	58%	74%
Penikese	51	65	49	59
	47%	55%	51%	52%
Mean (#)	65.5	77.1	50.8	72.7
	±10.8	±12.4	±5.2	±11.3
Similarity (all islands) (%)	69.7	73.5	62.0	73.5
	±11.0	±9.4	±10.7	±10.2
Mean (#)	66.6	78.0	50.9	73.7
	±10.4	±12.3	±5.4	±11.1
Similarity (except Penikese) (%)	71.4	74.8	62.8	75.1
	±9.5	±8.3	±10.7	±8.7

Table 4. Extended.

WB	BO	AP	CE	DU	LU	MA
65						
100%						
46	94					
58%	100%					
53	85	123				
56%	78%	100%				
56	81	97	112			
63%	79%	83%	100%			
53	80	93	91	110		
61%	78%	80%	82%	100%		
54	82	100	102	94	116	
60%	78%	84%	89%	83%	100%	
53	68	82	85	85	88	94
67%	72%	76%	83%	83%	87%	100%
57	89	110	104	97	104	88
57%	77%	85%	84%	79%	83%	77%
56	77	95	94	91	95	81
54%	74%	81%	84%	82%	83%	78%
52	76	93	92	91	92	81
61%	76%	81%	84%	84%	83%	81%
45	67	73	72	68	66	60
46%	60%	57%	59%	56%	53%	53%
53.9	73.0	86.1	84.3	81.7	84.5	74.5
±6.2	±13.3	±18.2	±16.4	±15.9	±18.0	±13.3
64.5	73.5	75.5	77.9	76.1	76.7	76.2
±12.2	±9.8	±11.6	±10.8	±10.9	±12.2	±10.6
47.6	73.4	87.1	85.2	82.6	85.9	75.5
±18.4	±13.7	±18.5	±16.7	±16.0	±17.8	±13.2
65.8	74.5	76.8	79.2	77.6	78.4	77.9
±11.5	±9.4	±10.8	±9.9	±9.9	±10.8	±8.9

Table 4. Extended, continued.

	SM	ST	WH	PI	Grand Mean
South Wolf					
Campobello					
Kent					
Penobscot Bay "composite"					
Wooden Ball					
Boon					
Appledore					
Cedar					
Duck					
Lunging					
Malaga					
Smuttynose	136 100%				
Star	106 85%	113 100%			
White	98 81%	90 82%	106 100%		
Penikese	77 58%	69 57%	63 53%	131 100%	
Mean (#)	92.4 ±20.2	83.3 ±16.5	80.2 ±16.2	67.7 ±19.1	75.2 ±11.4
Similarity (all islands) (%)	75.7 ±11.8	76.0 ±11.7	76.1 ±12.1	57.1 ±12.5	72.3 ±6.0
Mean (#)	92.4 ±20.2	84.3 ±16.7	81.4 ±16.1		76.8 ±12.7
Similarity (except Penikese) (%)	77.0 ±11.2	77.4 ±10.9	77.7 ±10.1		74.7 ±4.7

that lived freely in their woods and roamed the shores to catch fish (Simpson 1987). The Thorofare, a passage between North Haven and Vinalhaven (Figure 2), was a prehistoric deep valley between mountains. Ragged (Criehaven), Wooden Ball, and Matinicus Islands, plus Matinicus Rock, represent the most exposed habitats seaward of the Fox Islands. Matinicus Rock (commonly called The Rock), with its lighthouse, is the outermost marker for Penobscot Bay and the coast of Maine. It consists of about 13 hectares of precipitous granitic ledges arising from the continental shelf 3.1 km seaward of Matinicus Island. The Rock serves as a rookery for Atlantic Puffin, and it is one of only a few islands in the western Atlantic where these birds nest (Porter 1966; Simpson 1987).

The Fox Islands (Figure 2) divide Penobscot Bay into western and eastern basins (Doyle et al. 1970). On the northern portion of West Penobscot Bay, two deep channels (over 52 m) extend along both sides of Islesboro Island and then coalesce further seaward (to the south). Deep water habitats, therefore, are in close proximity to the land in West Penobscot Bay. Seaward of Islesboro, several channels breach the sill between the two Bays, allowing east-west access via Two Bush Island Channel and between Matinicus and Wooden Ball Islands near Bantam Ledge. The Bay's western shore has numerous coastal irregularities that mark the harbor towns of Searsport, Belfast, Camden, Rockport, and Rockland. The upper half of the eastern shore is very irregular, with Castine, Harborside, and Cape Rosier forming major harbors; the mid-eastern shore is characterized by numerous islands, the most prominent being Deer Isle and Isle Au Haut. Together, they form the boundary of East Penobscot Bay, i.e., offshore to the 50 fathom line (Conkling 1996).

Penobscot Bay is underlain primarily by rocks originating from the lower Paleozoic (Doyle et al. 1970). These former sedimentary rocks are highly metamorphosed into complex schists and gneisses. Granitic outcrops are most common on the north and east sides. The mean tidal range varies spatially from about 1.2–3.6 m (Anonymous 1985). Tidal currents average 2.5 knots, except within upper Bay channels (between islands) where they can range from 4 to 7 knots. Because of these strong currents, water masses below 9.0 m are remarkably homogeneous, with salinities varying from 29.9–31.8 ‰. As noted previously, the Penobscot River is the major source of fresh water to the Bay; it

is also the second largest drainage basin within New England (Anonymous 1989), draining Hancock, Penobscot, and Waldo Counties. Its tidal limits extend inland about 22.0 km to a tidal dam in Bangor. A series of minor rivers and streams drains into the area, including the Passagassawakeag River at Belfast, the Union and Megunticook Rivers from Camden Hills, and the Bagaduce River from the Castine and Cape Rosier basins on the east side of the estuary.

In characterizing environmental quality within Penobscot Bay, Larsen (1992) states that nickel and zinc concentrations within some sediments are moderately high (29 and 88 ppm dry weight, respectively). The concentrations of other contaminants (chromium, copper, lead, polychlorinated biphenyls, and polycyclic aromatic hydrocarbons) are elevated locally and well above preindustrial levels (Larsen et al. 1984a, b). For example, sediment polycyclic aromatic hydrocarbons in Penobscot Bay averaged 2,600 ppb (Johnson et al. 1985) versus 4,300 ppb for Casco Bay (Larsen et al. 1983). Surprisingly, such values are comparable to some of the most industrialized regions of the world (Larsen 1992). Typically, industrial contamination is highest near the head of the Bay, indicating that river flow is the major pathway into this marine environment. The occurrence of uniform sediment chromatographs also suggests that the major source of contamination is via runoff of compounds deposited within the Penobscot Bay watershed.

RESULTS

Species composition, distribution, and longevity patterns. Ninety-seven seaweed taxa, which include 25 Chlorophyceae, 34 Phaeophyceae, and 38 Rhodophyceae, were collected from the nine islands within the Penobscot Bay area (Table 3). Species richness per island is highly variable (Figure 4) and appears to be a function of collecting frequency (Table 1). The highest numbers of taxa and percentages of the total flora were recorded from Wooden Ball (65 taxa, 67%), Monhegan (64 taxa, 66%), and Hurricane Islands (45 taxa, 46%) where 4 or 5 collections per site were made; the lowest numbers were recorded from Allen (4 taxa, 4%) and Two Bush Islands (10 taxa, 10%), where single collections were made. Green, brown, and red algae are most diverse on Wooden Ball (21, 23, and 21 taxa, respectively) and

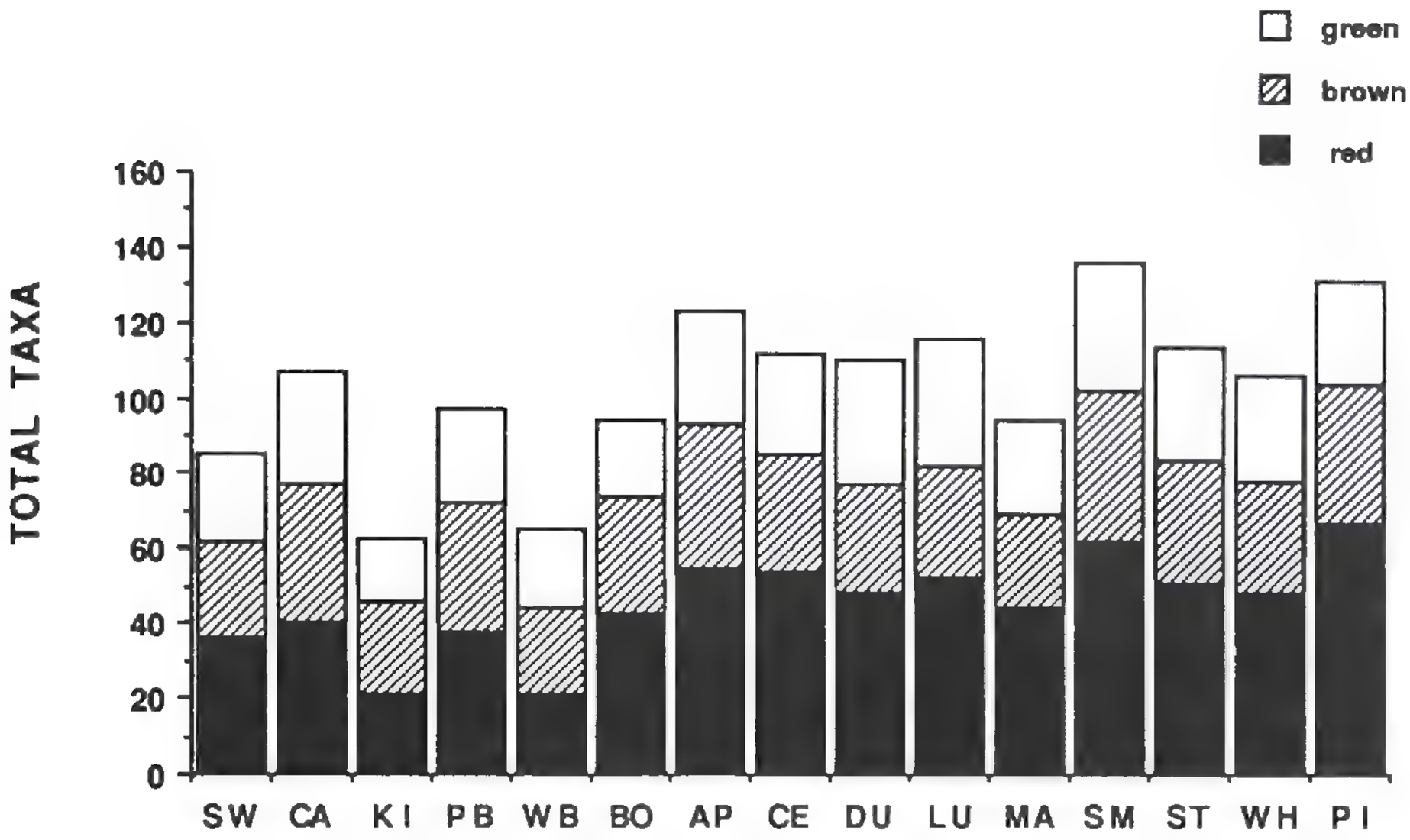


Figure 4. The number of seaweed taxa (green, brown and red) at fourteen individual islands from the Bay of Fundy, Canada, to Buzzards Bay, Massachusetts, plus a "composite" of nine islands from the Penobscot Bay area of Maine. Abbreviations: SW = South Wolf I., New Brunswick; CA = Campobello I., New Brunswick; KI = Kent I., New Brunswick; PB = a "composite" of nine islands from the Penobscot Bay area of Maine (ME)—i.e. Allen, Hurricane, Long, Marshall, McGlathery, Monhegan, Pond, Two Bush, and Wooden Ball Islands; WB = Wooden Ball I., Penobscot Bay, ME; BO = Boon I., ME; AP = Appledore I., ME; CE = Cedar I., ME; DU = Duck I., ME; LU = Lunging I., NH; MA = Malaga I., ME; SM = Smuttynose I., ME; ST = Star I., NH; WH = White I., NH; PI = Penikese I., MA.

Monhegan (14, 21, and 29 taxa), intermediate on Hurricane (9, 18, and 18 taxa) and Long Islands (8, 14, and 14 taxa), and lowest on Allen (0, 3, and 1 taxa). Overall, the mean number of taxa per island is very low, being 30.8 ± 23.0 SD; the green algae contribute 6.9 ± 7.0, the brown algae 11.4 ± 7.7, and the red algae 12.4 ± 9.0.

As outlined in Figure 5 and Table 3, 34 of the 97 total taxa from the Penobscot Bay area (10 green, 14 brown, and 10 red algae) are restricted to a single island (11.1% occurrence), while 23 taxa (7 green, 3 brown, and 13 red algae) occur on two islands (22.2% occurrence). Thirty seaweeds occur on 4–9 islands (44.4–100% occurrence); this includes 6 greens, 12 browns, and 12 reds. The most ubiquitous taxa are *Elachista fucicola* and *Pilayella littoralis* (100% occurrence); *Fucus vesiculosus* and *Chondrus crispus* occur at 88.9% of the sites, while *Rhizoclonium tortuo-*

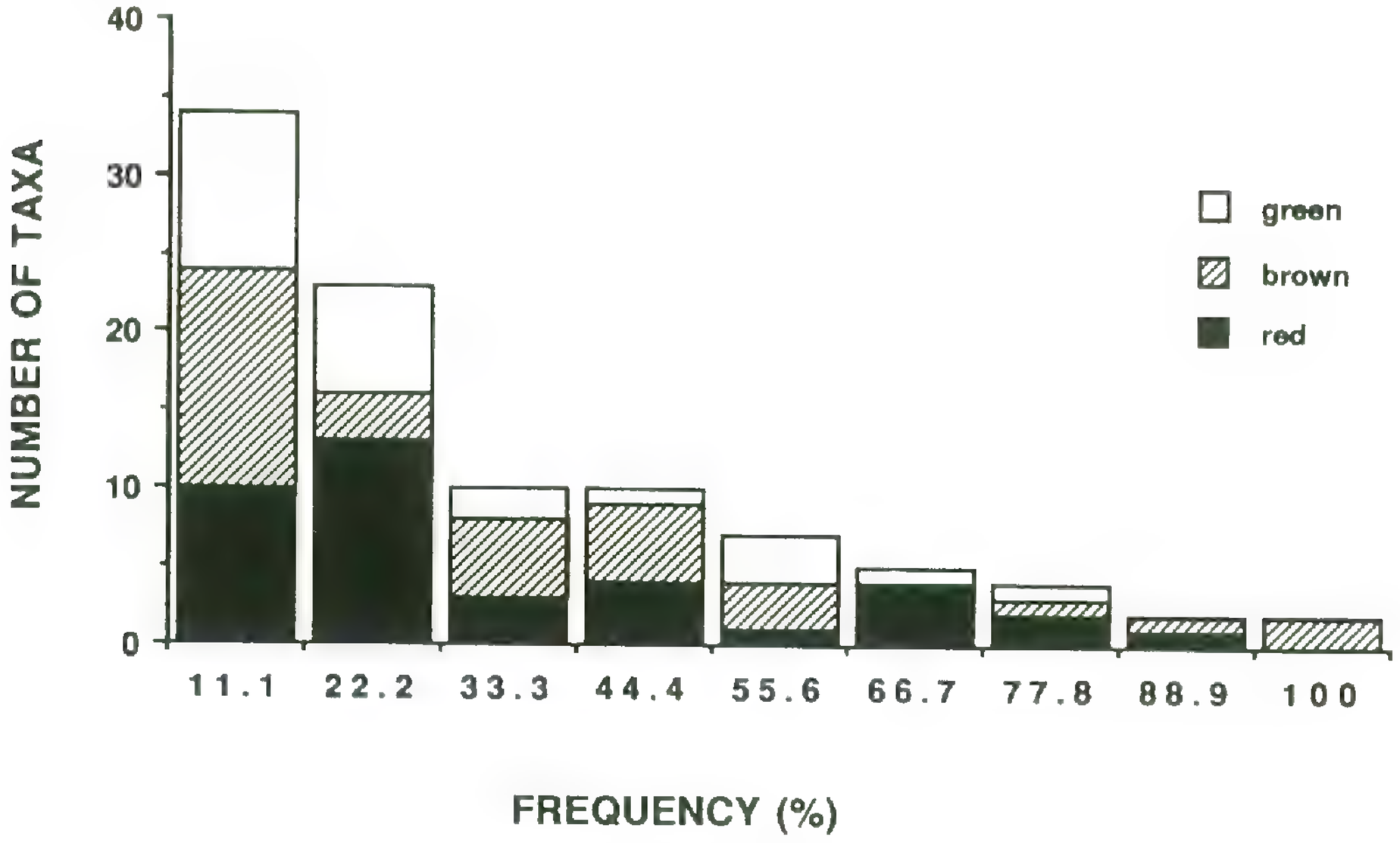


Figure 5. Frequency distribution patterns of 97 seaweed taxa recorded from nine islands within the Penobscot Bay area. Taxa found on only one of the nine islands (11.1% occurrence) are represented by the left-most bar of the graph; those found on only two islands (22.2%) are represented by the next bar, etc.

sum, Ascophyllum nodosum, and *Dumontia contorta* occur at 77.8% (Table 3).

The longevity patterns of seaweeds at each of the nine Penobscot Bay islands are summarized in Table 3. The numbers of annuals range from 29 taxa on Wooden Ball to only 1 on Allen Island (mean = 12.7 ± 10.7 taxa); perennials vary from 38 taxa on Monhegan to 3 on Allen Island (mean = 18.4 ± 12.5 taxa). The longevity ratios (annuals/perennials) at the various sites range from a maximum of 1 on Two Bush Island to 0.19 on McGlathery Island (mean = 0.65 ± 0.28). As shown in Figure 6, the "composite" flora consists of 48 annuals and 49 perennials, giving an overall longevity ratio of 0.98. With respect to individual groups, the green algae are predominantly annuals (19/25 or 76%), the brown algae are intermediate (18/34 or 53%), and the red algae exhibit the lowest percentage of annuals (11/38 or 29%).

Floristic comparisons. A total of 216 seaweed taxa (52 Chlorophyceae, 63 Phaeophyceae, and 101 Rhodophyceae) is recorded from fourteen individual islands, ranging from the Bay of Fundy (South Wolf Island, New Brunswick) to Buzzards Bay

(Penikese Island), Massachusetts, including a "composite" of Penobscot Bay's insular flora (Table 2; Figure 4). The "composite" data are presented due to limited seasonal and subtidal collections from individual islands within the Penobscot Bay area; collections from Wooden Ball provide the most realistic representation of an individual island within this embayment. Overall, the highest numbers of species are recorded from Smuttynose (136 taxa) and Penikese Islands (131 taxa), with Kent, Monhegan, and Wooden Ball Islands having the lowest numbers (63–65 taxa). Penobscot Bay's "composite" insular flora (97 taxa) exceeds the last three sites, as well as those of South Wolf (85 taxa), Boon, and Malaga Islands (94 taxa each). The last-named site is the smallest island within the Shoals archipelago. The two islands having the most diverse floras within the Penobscot Bay area (Table 3), Wooden Ball (65 taxa) and Monhegan (64 taxa), have approximately the same number of taxa as Kent Island (63 taxa), while the other thirteen individual islands (Table 2) have more diverse floras. Based upon the data in Table 2, the following values for species richness (mean ± SD) are calculated for the fourteen individual islands, plus the "composite" data for the Penobscot Bay area: (1) 103.9 ± 21.9 taxa for fourteen individual islands, excluding Penobscot Bay's "composite" value; (2) 106.2 ± 19.0 taxa for thirteen individual islands and Penobscot Bay's "composite," excluding Wooden Ball Island as an individual; (3) 106.9 ± 19.5 taxa for thirteen individual islands, excluding Penobscot Bay's "composite" value and Wooden Ball Island; (4) 101.8 ± 21.3 taxa for thirteen individual islands, excluding Penobscot Bay's "composite" and Penikese Island; (5) 104.3 ± 18.3 taxa for twelve individual islands and Penobscot Bay "composite," excluding Wooden Ball and Penikese Islands; (6) 104.9 ± 19.0 taxa for twelve individual islands, excluding Penobscot Bay "composite," Wooden Ball and Penikese Islands. Thus, the values are very uniform.

Figure 7 summarizes the distributional patterns of the 216 total seaweed taxa in Table 2 and is expressed as percent occurrence on fourteen individual islands, excluding the Penobscot Bay "composite." A bimodal pattern is evident, with peak numbers occurring at one and all fourteen islands. Fifty-one seaweeds are restricted to a single island (7.1% occurrence), while 25 occur on all fourteen. The most ubiquitous taxa (100% occurrence) consist of 5 green algae (*Blidingia minima, Chaetomorpha melagonium,*

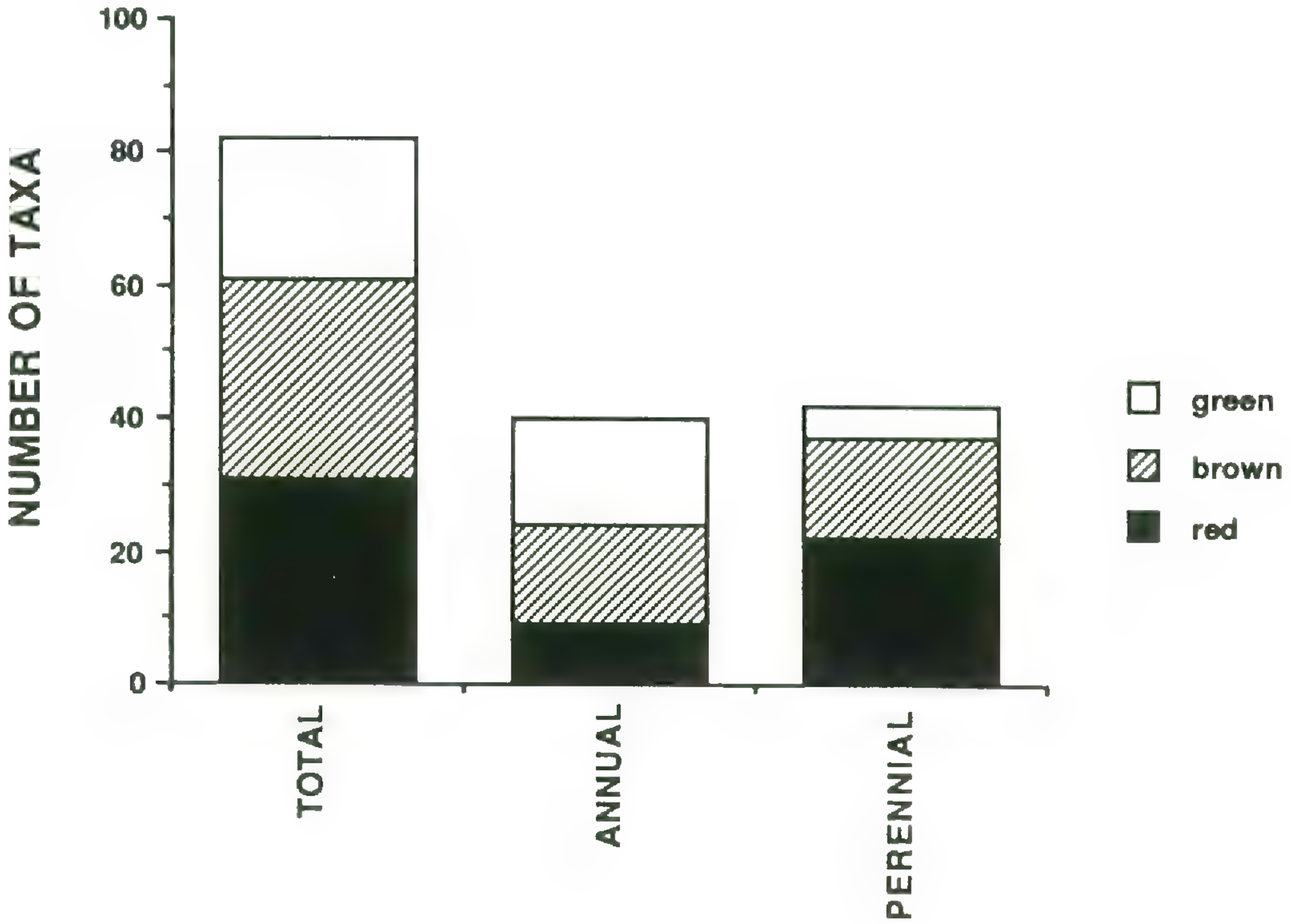


Figure 6. Longevity patterns of 97 seaweed taxa within Penobscot Bay area of Maine, expressed as the number of annuals, perennials, and total seaweed taxa.

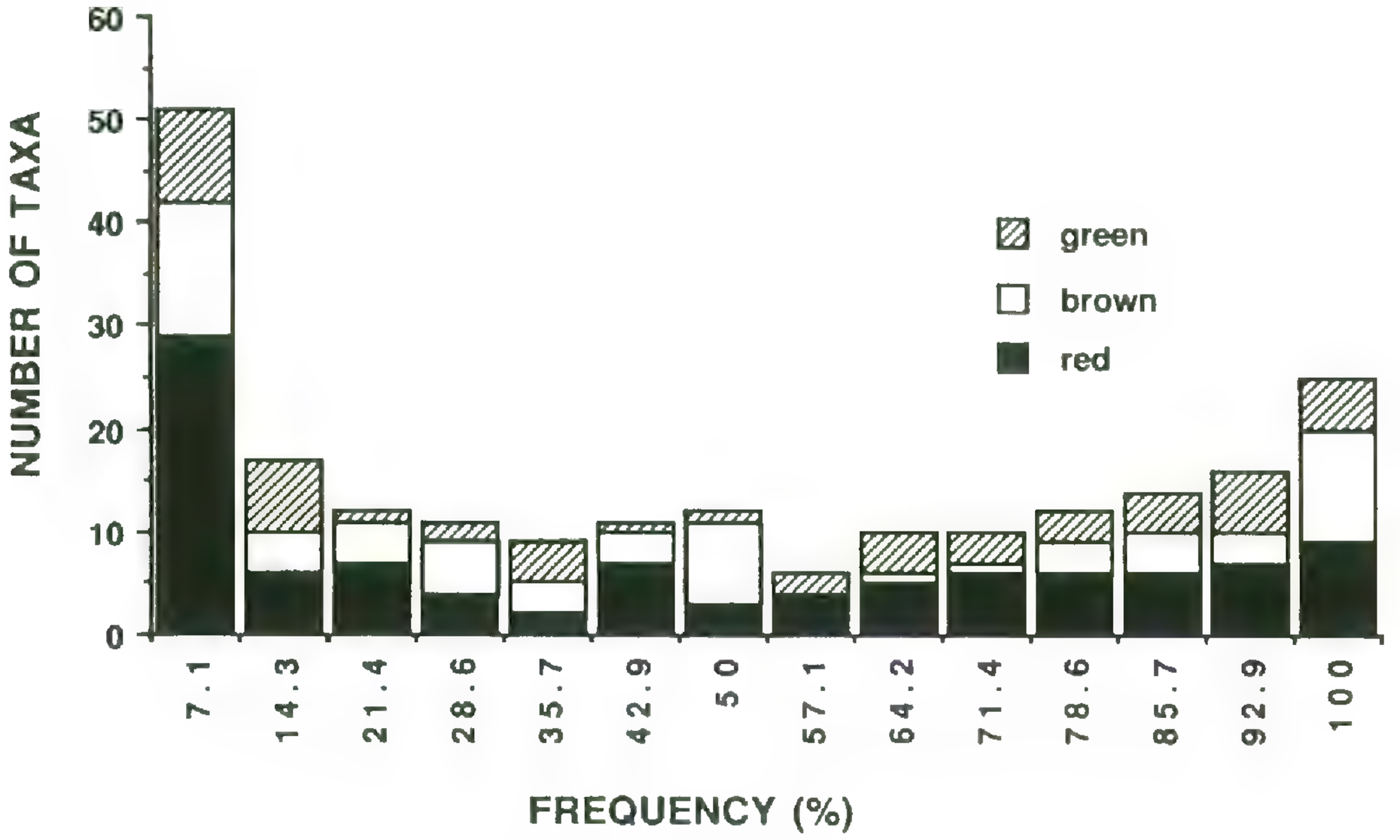


Figure 7. Frequency distribution patterns of 216 seaweed taxa recorded from fourteen individual islands from South Wolf Island, New Brunswick, to Penikese Island, Massachusetts. Taxa found on only one of the fourteen islands (7.1% occurrence) are represented by the left-most bar of the graph; those found on only two islands (14.3%) are represented by the next bar, etc.

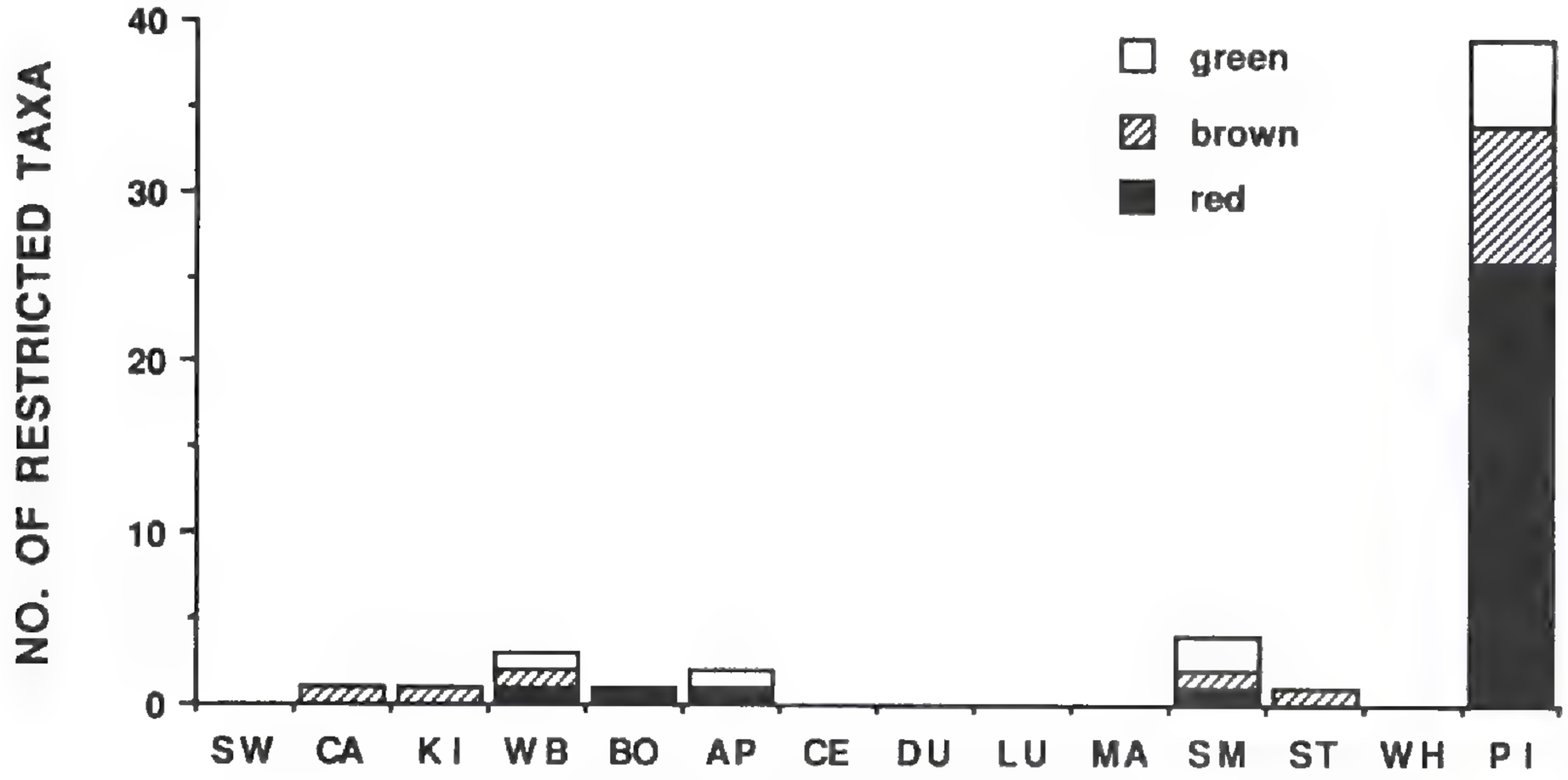


Figure 8. Spatial occurrence of restricted taxa on fourteen individual islands.

Enteromorpha intestinalis, E. linza, and *Ulva lactuca*), 11 brown algae (*Ascophyllum nodosum, Chordaria flagelliformis, Ectocarpus siliculosus, Elachista fucicola, Fucus distichus* ssp. *evanescens, F. spiralis, F. vesiculosus, Laminaria digitata, L. saccharina, Pilayella littoralis,* and *Scytosiphon simplicissimus*), and 9 red algae (*Ahnfeltia plicata, Ceramium nodulosum, Corallina officinalis, Cystoclonium purpureum, Palmaria palmata, Polysiphonia lanosa, P. stricta, Porphyra umbilicalis,* and *Rhodomela confervoides*).

Figure 8 outlines the spatial occurrence of 51 "localized" taxa or those restricted to only one of the fourteen individual islands from the Bay of Fundy to Buzzards Bay (Table 2). Penikese has the largest number of these taxa (38), consisting of 5 green, 7 brown, and 26 red algae. The other 13 localized taxa occur on the following islands: Appledore (*Pringsheimiella scutata* and *Pantoneura baeri*), Boon (*Lomentaria clavellosa*), Campobello (*Dictyosiphon macounii*), Kent (*Ascophyllum nodosum* ecad *scorpioides*), Smuttynose (*Chaetomorpha minima, Ulvaria oxyspersma, Laminariocolax tomentosoides, Sphacelaria fusca,* and *Halosacciocolax kjellmanii*), Star (*Cladostephus spongiosus* forma *verticillatus*), and Wooden Ball (*Chlorochytrium cohnii* and *Petroderma maculiforme*).

Table 4 summarizes floristic affinities of fourteen individual islands plus a "composite" for the Penobscot Bay area, with values expressed as the mean number and percentage of shared taxa

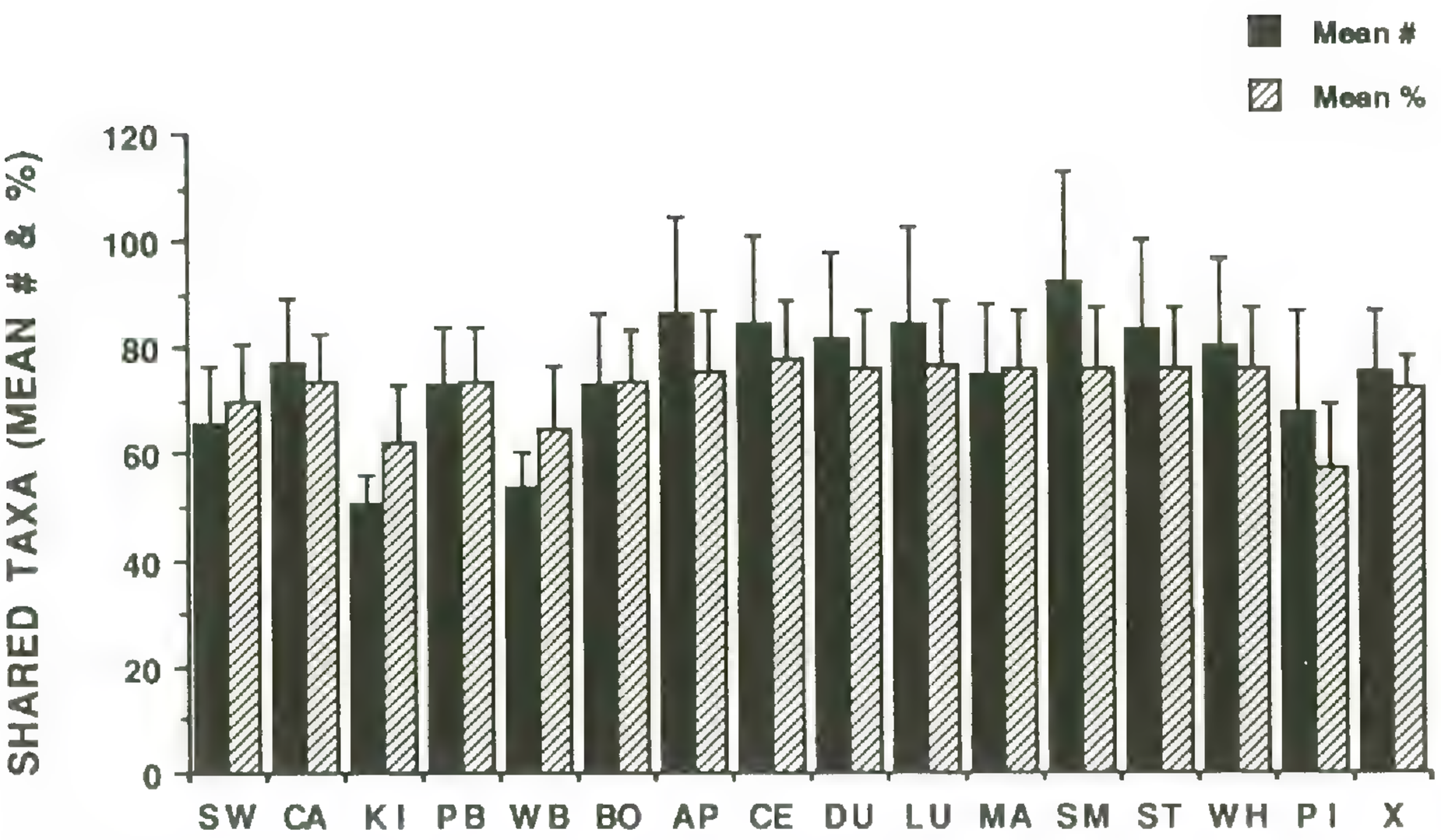


Figure 9. Mean number and percentage (±SD) of shared taxa/site at fourteen individual islands from the Bay of Fundy, Canada, to Buzzards Bay, Massachusetts, plus a "composite" of nine islands from the Penobscot Bay area of Maine. See Figure 4 for abbreviations. X = overall mean value.

per island and per total sites. The combined mean values for all fifteen sites are relatively high (75.2 ± 11.4 taxa and 72.3 ± 6.0%). Of the fifteen sites, Smuttynose has the most diverse flora (136 taxa), the highest mean number of shared taxa (92.4 ± 20.2), and an intermediate percent similarity pattern (75.7 ± 11.8%). By contrast, Kent Island, with a flora represented by only 63 taxa, exhibits the lowest mean number of shared taxa (50.8 ± 5.2) and a percent similarity of 62.0 ± 10.7%. Penikese Island, with 131 total and 38 "localized" taxa, has only 67.7 ± 19.1 shared taxa and the lowest percent similarity value recorded (57.1 ± 12.5%). An analogous comparison of fourteen sites (excluding Penikese Island) shows slightly higher mean values of 76.8 ± 12.7 taxa and 74.7 ± 4.7% (Table 4). Smuttynose, with its diverse flora, has the highest number of shared taxa (92.4 ± 20.2) and intermediate percent similarity (77.0 ± 11.2%), while Kent and Woodens Ball Islands show the lowest numbers (50.9 ± 5.4 and 47.6 ± 18.4) and percent similarity values (62.8 ± 10.7% and 65.8 ± 11.5%). A graphical summary of the average number of shared taxa and percent similarity patterns for the fifteen insular sites is given in Figure 9.

The floristic affinities of Penobscot Bay's "composite" insular flora are illustrated in Figure 10, with the number and percent

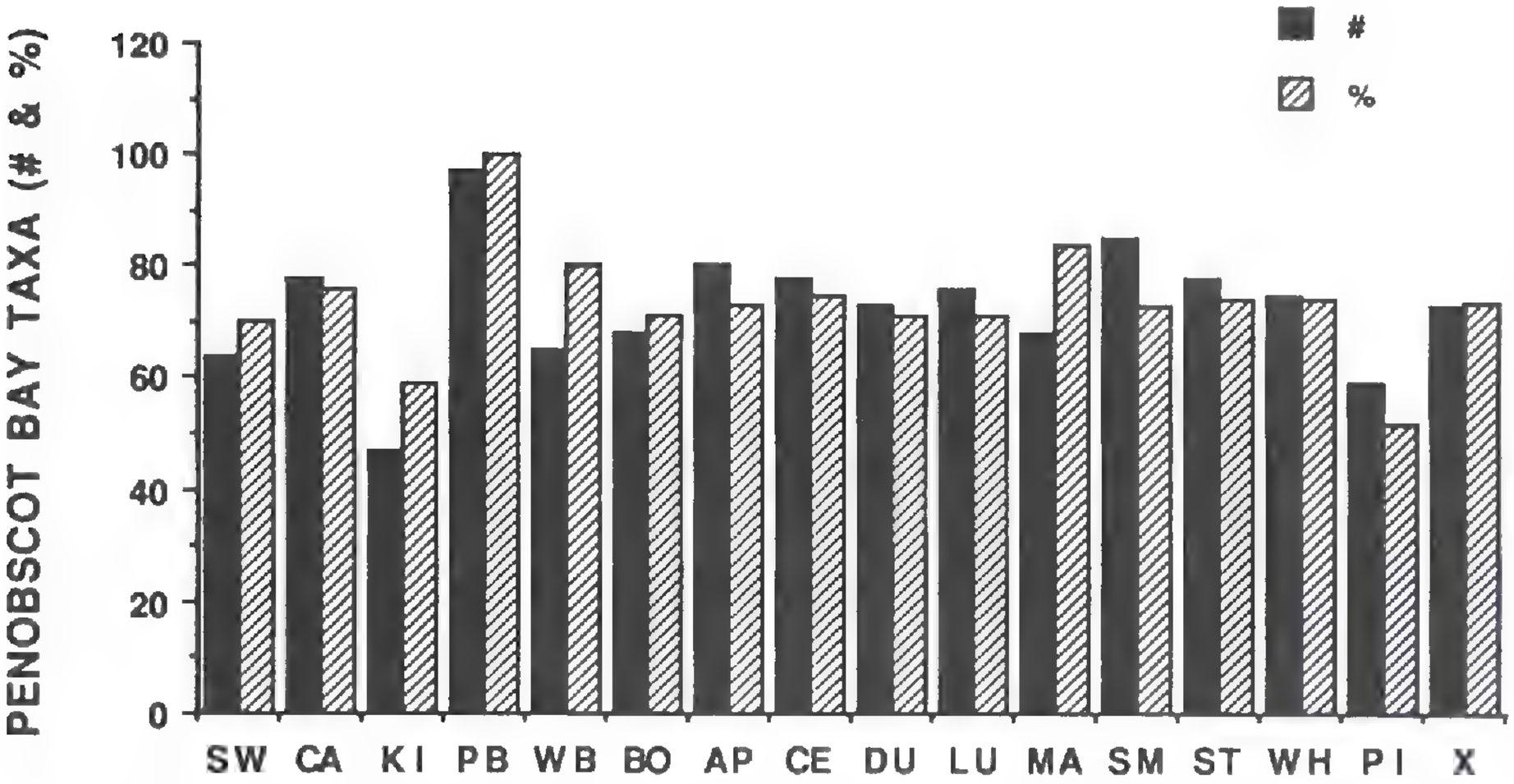


Figure 10. Number and percentage of Penobscot Bay taxa ("composite") at fourteen individual islands from the Bay of Fundy, Canada, to Buzzards Bay, Massachusetts, including overall mean values. See Figure 4 for abbreviations.

similarity values for the other fourteen islands given in Table 4. As noted above, floristic affinities of individual islands tend to "mimic" patterns of species richness. The highest numbers of shared taxa occur on Smuttynose (85 taxa) and Appledore Islands (80 taxa), while Kent and Penikese Islands show the lowest numbers (47 and 59 taxa, respectively). By contrast, the percent similarity values are highest on Malaga (84%) and lowest on Penikese (52%) and Kent Islands (59%). The mean number and percent similarity of Penobscot Bay taxa on all fourteen islands are 72.7 ± 11.3 taxa and 73.5 ± 10.2%, respectively. An analogous calculation for thirteen islands (minus Penikese) gives slightly higher mean values of 73.7 ± 11.1 taxa and 75.1 ± 8.7%.

DISCUSSION

Although Penobscot Bay is the largest embayment on Maine's irregular coastline (Apollonio 1979; Doyle et al. 1970; Platt 1996; Porter 1966), its algal flora has been documented previously by only a few published records of individual taxa. For example, Taylor (1957) gives no specific records for the Bay, simply citing Maine. However, in a discussion of historical data (p. 22), he mentions the early Maine collections of Franklin W. Hooper that are deposited in BKL. A recent examination of these collections

revealed that they were, in fact, collected by John Hooper during September 1851 and bequeathed to the Long Island Historical Society upon his death in 1869. Most of John Hooper's Penobscot Bay collections are from inshore sites near Camden, Maine, while the precise locations of others are not given. The collections at BKL also include several isotypes. The fact that F. W. Hooper was born just seven months prior to the Camden collections in 1851 confirms this misinterpretation. Perhaps F. W. Hooper's affiliation with Harvard University and W. G. Farlow, and his subsequent directorship (1889) at the Brooklyn Institute contributed to this confusion (Anonymous 1887, 1906).

Eaton (1873) mentions *Ceramium hooperi* from Penobscot Bay, noting that it was collected by Hooper and named by W. H. Harvey for its discoverer. The name now is considered conspecific with *C. deslongchampii* (South and Tittley 1986; Taylor 1957). Seven additional taxa documented by Hooper (in NHA and BKL) have not been observed by us: *Cladophora rupestris, Enteromorpha clathrata, Stilophora rhizoides, Myriotrichia clavaeformis, Gymnogongrus crenulatus, Polyides rotundus,* and *Gracilaria tikvahiae* (Tables 2 and 3). With the exception of *S. rhizoides* and *G. tikvahiae,* which are warm-water disjuncts in the northwest Atlantic (South and Tittley 1986; Taylor 1957), the other five taxa are likely to occur on nearshore islands within Penobscot Bay (Appendix). The coastal occurrence of *G. tikvahiae* and *S. rhizoides* in Maine is particularly noteworthy (Bourque 1996). We have collected *Gracilaria* only from shallow estuarine habitats in northern New England: the Great Bay Estuary System of Maine/New Hampshire (Mathieson and Hehre 1986), the Salt Bay area near Newcastle, Maine, and within the upper reaches of the New Meadow River near Bath, Maine. *Stilophora rhizoides* has been found only within the same Salt Bay area in Newcastle. The NHA specimen of *G. tikvahiae* from Penobscot Bay was initially identified by J. Hooper as *Gymnogongrus norvegicus*; there are, however, correctly identified specimens of both taxa within Hooper's collections (BKL).

Collins (1891, 1896a, b, 1899, 1901) collected at several inshore (Camden and Cape Rosier) and insular habitats within the Penobscot Bay area (Eagle, Great Duck, Spectacle, and York Islands). We have found most of the taxa documented by Collins, with the following exceptions: *Cladophora albida, C. ruchingeri, Gononema aecidioides, "Hecatonema maculans," Leptonematel-*

la fasciculata, Ralfsia fungiformis, Streblonema fasciculatum, Ceramium strictum, and *Erythrodermis traillii.* As noted by Hoek (1982), *Cladophora ruchingeri* was identified initially by Collins (1899) as *Cladophora gracilis* forma *elongata,* based upon collections from Spectacle Island. An isotype of this taxon is deposited in the Farlow Herbarium (*Phycotheca Boreali-Americana* #725). Although there are several other records of *C. ruchingeri* from Maine's open coast (Hoek 1982, p. 20), our New England records are restricted to a single estuarine tidal rapids site at Dover Point, New Hampshire.

Aside from the 97 insular (Table 3) and 16 historical records noted above, we have recently documented 26 additional taxa from more than 70 inshore Penobscot Bay habitats (Mathieson and Hehre, unpubl. data). These include 11 green algae (*Bryopsis plumosa, Capsosiphon groenlandicum, Codiolum pusillum, Enteromorpha compressa, E. torta, Epicladia flustrae, Microspora pachyderma, Percursaria percursa, Prasiola stipitata, Ulothrix speciosa,* and *Ulvaria oxysperma*), 6 brown algae (*Ascophyllum nodosum* ecad *scorpioides, Chorda filum, Desmarestia viridis, Fucus vesiculosus* ecad *limicola, Hincksia granulosa,* and "*Ralfsia bornetii*"), and 9 red algae (*Audouinella dasyae, A. membranacea, Erythrotrichia carnea, Erythrotrichopeltis ciliaris, Peyssonnelia rosenvingii, Porphyra leucosticta, Ptilota serrata, Saccheria fucina,* and *Stylonema alsidii*). Thus, a total of 139 seaweed taxa is recorded from the Penobscot Bay area, which is slightly greater than floristically diverse islands like Smuttynose (136) and Penikese Islands (131 taxa) but less than that of nearby Casco and Passamaquoddy Bays within southern Maine and New Brunswick, respectively (Collins 1911; Tittley et al. 1987).

The reduced mean number of taxa per island within Penobscot Bay (30.8 ± 23.0) versus the Isles of Shoals (114.0 ± 11.4) should be noted (Mathieson and Penniman 1986b). While riverine contamination within Penobscot Bay (Larsen 1992; Larsen et al. 1984a, b) might be a contributing factor to this low species diversity, several islands are considerably offshore (Appendix), diminishing the effects of nearshore pollution. More likely, the low diversity is associated with the very sheltered nature of Penobscot Bay (Collins 1899), which would allow a dominance of selected taxa (Mathieson et al. 1991; Tittley et al. 1987; Vadas et al. 1976). Further, the occurrence of limited seasonal and subtidal collections is no doubt a contributing factor (Mathieson 1979; Mathie-

son and Penniman 1986a), as well as the fact that only 9 of several hundred islands were studied (Hill 1923). For the above reasons, it is premature to make any detailed statistical inferences of insular species richness within Penobscot Bay as a function of area, shoreline length or exposure to wave action (Mathieson and Penniman 1986b). For example, the lowest number of taxa is found on Allen Island (4 taxa) having a shoreline of approximately 7620 m, while the highest number of taxa (65) is found on Wooden Ball with a smaller shoreline of about 5560 m (Table 3; Appendix).

As noted previously, we are aware of only two comparative studies of insular marine floras in North America, those involving the Channel Islands in Southern California (Murray and Littler 1981; Murray et al. 1980) and the Isles of Shoals in southern Maine/New Hampshire (Mathieson and Penniman 1986b). Although both archipelagos contain eight islands, this is where the analogies end. The maximum distance between islands at the Shoals is very small (4.8 km) and individual islands exhibit a wide range of wave exposure and relatively uniform hydrography and substrata (Sze 1982). By contrast, the distances between the individual Channel Islands are much greater and they collectively extend over a much broader geographical range. They occur just offshore and south of Point Conception and their oceanographic and meteorological conditions are complex and spatially variable due to the proximity of the cold California Current and the warm Southern California Countercurrent (Lüning 1990). Not suprisingly, the floristic similarities of the Channel Islands are relatively low (mean = 45.4%) and the different islands contain a mixture of both northern and southern elements. Even so, the islands have their greatest affinities with the mainland south of Point Conception, while individual islands exhibit a pattern of variable affinities to the central California flora. In contrast to such low floristic affinities and spatially variable and complex oceanographic parameters within the Southern California Bight, oceanographic conditions within the Gulf of Maine are more stable spatially (Mathieson and Penniman 1986b; Mathieson et al. 1991). Such uniformity may contribute to the relatively high floristic affinities of Gulf of Maine islands as a whole (mean = 72.3 ± 6.0%; Table 4). Surprisingly, an analogous comparison of the percent similarity of Gulf of Maine sites, minus the southernmost Penikese Island, shows only a slightly higher mean value of 74.7 ± 4.7%.

Thus, floristic similarities within these Northwest Atlantic islands are much higher than those of the Channel Islands, which show maximum and minimum interisland values of 64.2 and 32.6%, respectively. In contrast to the latter situation, Scagel (1963) emphasizes that the northeast Pacific flora is relatively uniform and exhibits a gradual transition in species composition from northern California to Sitka, Alaska. Such patterns are more comparable to those of the Gulf of Maine and Bay of Fundy (Figure 9).

A comparison of the floras north and south of Cape Cod (the Gulf of Maine and Bay of Fundy versus Buzzards Bay) reveals differences in species richness and numbers of warm-temperate taxa (Lüning 1990). For example, of the different insular sites discussed above (Figure 7; Table 2), only Smuttynose has more taxa (136) than Penikese (131). Amazingly, the Penikese records are based almost entirely upon summer collections from the intertidal and shallow subtidal zones (Doty 1948; Jordan 1874; Lewis 1924), while those from Smuttynose are based upon detailed seasonal collections of both intertidal and subtidal seaweeds (to the lower limits of vegetation). No doubt, enhanced seasonal and subtidal collections on Penikese would increase the number of known taxa. In a detailed seasonal study of subtidal seaweeds (from 1.2 to 41.0 m) within nearby Martha's Vineyard, Waquoit Bay, and Buzzards Bay, Sears and Wilce (1975) record 132 taxa, consisting of 13 Chlorophyceae, 52 Phaeophyceae, and 67 Rhodophyceae. Thus, a total of 187 taxa is recorded from Penikese and adjacent subtidal sites, which is comparable to the entire Gulf of Maine (Mathieson and Hehre 1986; Mathieson and Penniman 1986b; South and Tittley 1986). Seventy-six of these taxa are common throughout the region (6 Chlorophyta, 24 Phaeophyta, 46 Rhodophyta), while 55 are restricted to Penikese (19 Chlorophyta, 14 Phaeophyta, 22 Rhodophyta) and 56 are recorded only by Sears and Wilce (7 Chlorophyta, 28 Phaeophyta, 21 Rhodophyta). Overall, the intertidal flora at Penikese has a greater number of green algae, while crustose browns are more common at the adjacent subtidal sites.

In a comparison of multiple nearshore sites north and south of Cape Cod, Massachusetts, Coleman and Mathieson (1975) found an enhancement of annuals to the south, while perennials were more abundant to the north. They state that greater numbers of annuals occur where large temperature amplitudes are evident south of Cape Cod, while the opposite pattern exists with reduced

temperature variations north of the Cape. Similarly, Littler and Littler (1981) state that annuals or opportunistic forms dominate in seasonally disturbed environments due to catastrophic environmental fluctuations, while long-lived perennials are more conspicuous in environmentally constant habitats.

Mathieson and Penniman (1986b) summarize longevity ratios (#annual/#perennial taxa) for 11 island floras and 4 nearshore habitats, from South Wolf Island, New Brunswick, to Woods Hole, Massachusetts; the values vary from 1.29 (Woods Hole) to 0.66 (Scituate), with an overall mean of 0.85 (greater # of perennials than annuals). The latter value (0.85) is intermediate between Penobscot Bay's "composite" flora (0.97) and the mean for the nine individual islands (0.65 ± 0.28). Mathieson and Penniman (1986b) also note that similar values may result from different combinations of perennials and annuals. They find a ratio of 0.95 for Smuttynose Island, an exposed offshore habitat within the Isles of Shoals, and at Dover Point, a mid-estuarine site, with the two calculations based upon values of 61 annuals/64 perennials and 45 annuals/47 perennials, respectively. Comprehensive seasonal and spatial collections (intertidal and subtidal) are obviously necessary before any meaningful comparisons of such ratios can be made. The wide range of values in Table 3 confirms the preliminary nature of the individual insular collections within Penobscot Bay.

ACKNOWLEDGMENTS. We acknowledge the support of The Island Institute staff of Rockland, Maine, who provided logistical and boat support to one of us (JH) via their Outward Bound Program on Hurricane Island. We are indebted also to Kerry Barringer, Steve Clemants, and Linda Marschener (BKL) for their invaluable assistance with the John Hooper algal collections and for information on both John and Franklin Hooper, and to Don Pfister and Gennaro Caccavio at FH for their help with the collections of W. G. Farlow. Published as Scientific Contribution Number 1905 from the New Hampshire Agricultural Experiment Station; also issued as Contribution Number 294 from the Jackson Estuarine Laboratory and the Center for Marine Biology.

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APPENDIX: STUDY SITES WITHIN THE PENOBSCOT BAY (MAINE) AREA

1. Allen Island: one of the Georges Islands at the mouth of the St. George River on the southwesterly portion of Penobscot Bay, due north of Monhegan Island and south of Port Clyde (43°52′N, 69°19.8′W); ~7620m of shoreline.
2. Hurricane Island: located in the mid-central part of Penobscot Bay (44°02′N, 68°54.6′W), offshore from the southwesterly side of Vinalhaven Island and near Green Island; ~2930m of shoreline.
3. Long Island: located within Jericho Bay (44°07′N, 68°21.5′W), offshore (SE) from Swans Island and northeast from Isle Au Haut; ~16770m of shoreline. Collections were made on the NW side near Frenchboro.
4. Marshall Island: located within Jericho Bay (44°06.5′N, 68°30.5′W), offshore (S) from Swans Island and northeast from Isle Au Haut; ~11940m of shoreline. Collections were made in Baxam Cove.

5. McGlathery Island: located within Merchants Row of Penobscot Bay (44°08.5′N, 68°37′W), due north of Isle au Haut and south of Deer Isle; ~4020m of shoreline.
6. Monhegan Island: located seaward of Penobscot Bay (43°46′N, 69°19′W); due south of Allen Island and almost equidistant from New Harbor to the northwest and Port Clyde to the north; ~8567m of shoreline.
7. Pond Island: located within Jericho Bay (44°13.3′N, 68°28.6′W) due north of Swans Island; ~4318m of shoreline. Collections were made on the sheltered SE and NE sides.
8. Two Bush Island: located within the western part of Penobscot Bay, due east (and somewhat south) of Tenants Harbor, as well as SW of Hurricane Island (43°58.2′N, 69°04.3′W); ~1700m of shoreline.
9. Wooden Ball Island: located within the south central (exposed) part of the Penobscot Bay (43°51.3′N, 68°49.05′W), offshore (S) from Vinalhaven Island and Isle Au Haut (SW), and near Matinicus and Ragged Islands; ~5560m of shoreline. Collections were made on the sheltered NW and exposed eastern sides.

RHODORA, Vol. 98, No. 896, pp. 419–444, 1996

SURVEY OF OLD-GROWTH FOREST IN MASSACHUSETTS

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ABSTRACT. We surveyed forests in Massachusetts to identify any remaining old-growth stands. We located twenty-eight tracts in western Massachusetts that met our criteria, with one additional site east of the Connecticut River. Hemlock and northern hardwoods in excess of 150–200 years dominate most sites, which range in area from 3–28 ha. Most stands occur on steep slopes and may have escaped cutting due to their inaccessibility. Several potential sites remain to be investigated, but we do not expect that the total area of old-growth forests in Massachusetts will greatly exceed 260 ha. However, less stringent definitions of old growth may include additional sites and greater acreages.

Data collected from 26 permanent vegetation monitoring plots provide comparisons with other forests. Basal areas in the old-growth stands are similar to other old-growth forests in New England, from 34–42.8 m^2/ha; values are only slightly higher than basal areas from nearby second growth forests of the same type. Densities of stems >10 cm dbh in the old-growth plots are 347–480 trees/ha, 25–40% lower than in second growth forests. No vascular plant species were encountered that were unique to the old-growth stands.

Key Words: old-growth, northern hardwood forests, eastern hemlock, Massachusetts

Old-growth forests in the eastern United States have attracted considerable attention in the last decade, and increasingly are threatened in much of North America (Davis 1996). Such forests are important because they may contain unique assemblages of species, offer significant dendrochronological information on past tree growth, and provide valuable baseline information on forest composition and dynamics for comparison with other areas (Whitney 1987). Definitions vary among researchers, but forests that frequently are referred to as old growth are generally regarded to have had continuous forest growth over a long period with

little human disturbance (Leverett 1996; Whitney 1987). Examples have been reported in several New England states (Dunwiddie et al. 1996), including Maine (Maine Critical Areas Program 1983), Vermont (Bormann and Buell 1964), New Hampshire (Cline and Spurr 1942; Carbonneau 1986; Leak 1987), and New York (Leopold et al. 1988; Woods and Cogbill 1994). In Massachusetts, however, Egler (1940) reported finding no "pre-colonial" forests in his study of the vegetation in the Berkshires. One unpublished reference (Hosier 1969) presents data from a purported virgin stand in northwestern Massachusetts, but no evidence is provided to support the claim that the stand is, indeed, old growth. Thus, a primary purpose of our study was to determine whether any old-growth forest remains in Massachusetts.

Once we determined that old-growth forests existed in the state, three specific objectives were defined: (1) to identify and map existing old-growth forests in Massachusetts, (2) to compile a descriptive summary of the location, physical characteristics, flora, and structure of these sites, and (3) to determine how the Massachusetts old-growth stands compare with data from other forests in the northeastern United States. Detailed reports documenting features of the individual stands have been submitted to the Massachusetts Natural Heritage and Endangered Species Program (Dunwiddie 1991; Dunwiddie 1993). In this paper we provide an overview of all the known old-growth sites in Massachusetts, summarize some of the tree and understory data collected in this study, and compare results with other old-growth sites in New England.

The first step in identifying old-growth forests was to develop criteria that distinguish such stands from regrowth forests. We modified criteria used elsewhere in the Northeast (Maine Critical Areas Program 1983) to identify stands that would be considered by most researchers to be old growth. Using less conservative criteria, others might add to the acreage of old-growth forest in Massachusetts. However, our intention was to provide an inventory of fairly unequivocal sites that could be useful as a starting point for other investigations.

To qualify as old-growth forest, a stand must (1) be a relatively homogeneous area of at least 3 ha, (2) exhibit minimal evidence of human influence or other catastrophic disturbance of the stand, (3) show evidence of tree regeneration, especially of late-successional species, resulting in a relatively stable forest composition,

and (4) include dominant canopy trees of an age >50% of the maximum age for those species (Fowells 1965).

These criteria eliminated small or fragmented sites with little undisturbed forest interior, as well as stands dominated by early-successional species such as *Betula papyrifera* Marsh. (paper birch) and *Acer rubrum* L. (red maple). The second and fourth criteria eliminated areas where widespread blowdowns, landslips, and other disturbances removed old trees from dominance in stands. The determination of a minimum age for trees to be considered old growth is arbitrary, but application of the last criterion included stands dominated by *Tsuga canadensis* (L.) Carr. (eastern hemlock) >200–225 years old, and hardwoods such as *Acer saccharum* Marsh. (sugar maple) and *Fagus grandifolia* Ehrh. (American beech) >175–200 years old.

MATERIALS AND METHODS

Forests considered to be probable old growth were identified by extensive field searching, as well as by information provided by the Massachusetts Natural Heritage and Endangered Species Program, foresters, and other individuals. Although we considered potential sites throughout the state, our work fairly quickly became focused in western Massachusetts. Numerous sites were rejected due to small size, evident disturbance, or lack of old trees. Areas that appeared to meet our criteria were selected for more detailed study. Beginning in 1991, assessments were made of composition, signs of disturbance, area, and likelihood of sufficient age; selected increment cores were gathered from dominant trees to more accurately determine the age of the older individuals. General information was recorded on the species, slope, aspect, and elevation of each stand. A compass and altimeter were used to map the perimeter of old-growth stands on enlarged U.S. Geological Survey topographic maps. Stand acreage was calculated from these maps.

Even with well-defined criteria for identifying old-growth stands, mapping boundaries and determining acreages is still subject to considerable interpretation. The density of older trees necessary to qualify a stand as old growth is ultimately a subjective decision, and different perspectives adopted by other researchers could significantly change acreage estimates of old-growth forest in the state. Because of our desire to identify reasonably unequiv-

ocal sites, we only considered stands that included at least three older trees per hectare throughout the stand. In the field, this necessitated identifying probable old trees, and estimating their density on a site. Where old individuals were common and readily recognizable, decisions on the boundaries of old-growth stands were clear. However, where densities of old trees were low, or where trees lacked characteristics often associated with great age, such as deeply fissured bark, snag tops, or heavy limbs, mapping decisions were more difficult.

Detailed quantitative data on the canopy and understory vegetation were collected from within the twelve stands that had been identified by 1992. A standardized methodology developed for sampling old-growth forests was adapted from Shifley et al. (1991). Permanent 0.1 ha fixed-radius plots were located within each stand to collect tree data, with several nested plots for sampling other vegetation strata. Time constraints precluded installing the large number of randomly placed plots (often >30 for many parameters recommended by Shifley et al. 1991) to derive statistically valid descriptive samples of the entire stands. Instead, from one to four plots were established in locations that included several trees that were typical of the older trees in the stand. Where several different forest types were represented within a single stand, attempts were made to place plots to capture this variability in composition.

The plot layout follows Shifley et al. (1991) and consists of a 0.1 ha circular plot for trees, a 0.01 ha circular subplot for saplings, and four 2.5 m^2 subplots for ground vegetation. All living and dead trees >10 cm diameter at breast height (dbh) were recorded in the large plot, and saplings from 2–10 cm dbh were sampled in the 0.01 ha subplot. Each plot center was marked with a 2.5 cm plastic pipe. Data collected for each tree included azimuth and distance from the plot center, species, dbh, crown class and ratio, and decay stage.

At least two trees, estimated to be among the oldest trees in the plot based on size, bark, and crown characteristics, were cored. These cores were glued into mounts and sanded, and growth rings were counted to provide minimum ages. Actual ages were estimated by determining growth rates for the innermost several centimeters of the cores, calculating the distance to the center based on diameter measurements, and adding the appropriate number of years based on the extrapolated growth. At sev-

eral sites, heights were measured for individual trees using a tape measure and inclinometer.

Understory vegetation was sampled in four square subplots 3 m from the center of the main plot. Woody stems at least 1 m tall and less than 2 cm dbh were counted by species, and the abundance of each species in the subplots was recorded on a three-point scale. A species list also was compiled for each 0.1 ha plot and for each site as a whole.

In this paper, we present summaries of physical site characteristics, basal area and density data from living and dead trees in the different forest types, and understory compositional data. Vascular plant names follow Gleason and Cronquist (1991); bryophytes follow Conard and Redfearn (1979).

RESULTS

Twenty-eight old-growth stands in western Massachusetts were identified and described in this study (Tables 1 and 2). One additional site, Wachusett Mountain, was identified in central Massachusetts. Collectively, they include a total area of 255.2 ha. In addition, we identified ten other small stands of old growth in western Massachusetts, but did not include them here because the individual stands are less than 3 ha. We have yet to confirm whether Chesterfield Gorge, a 7 ha hemlock stand belonging to The Trustees of Reservations, is an old-growth forest that meets our criteria.

Quantitative data were gathered from 26 plots in 13 of the stands (Table 1). Most of the stands are small, generally less than 12 ha, and occur on steep slopes (av.=35°). Many stands are on northwest- to northeast-facing slopes and, with the exception of the Mt. Greylock sites, most occur at elevations from 300–500 m. Canopy trees ranged from about 24 m to 36 m tall.

The data on the total area of old-growth forest from the Mt. Greylock stands represent minimum estimates, and are likely to understate the true amount. The stands all are scattered within the area known as the Hopper, within which exists a complex disturbance matrix resulting from fire, landslides, blowdowns, and land use. The interspersion of old trees through much of the Hopper, individually and in larger stands, makes it difficult to delineate precise boundaries of areas that meet all the criteria of old growth defined in this study.

Table 1. Characteristics of old-growth stands with permanent vegetation monitoring plots in Massachusetts. Different stands within each site are distinguished by letters or local names. H = Hemlock, NHW = Northern hardwoods. All sites are owned by the Massachusetts Department of Environmental Management with the exception of Bash Bish A, which is private.

	Stand		
Site Name	Size (ha)	Lat. (N)	Long. (W)
Bash Bish			
A-Grinder	6.9	42°6′	73°29′
B-Falls	5.6	42°7′	73°30′
Cold River			
A	7.6	42°38′	72°58′
B-Black Bk.	4.5	42°37′30″	72°58′30″
C	16.6	42°38′	72°58′30″
D	28.2	42°38′	72°59′
E-Manning Bk.	5.3	42°38′30″	72°59′30″
Dunbar Bk.	13.1	42°42′	72°58′
Parsonage	4.2	42°43′	72°59′
Fife Bk.	9.5	42°41′30″	72°59′
Mt. Greylock			
Deer Hill	11.6	42°38′	73°11′
Money Bk.	9	42°39′30″	73°10′30″
Mt. Everett	9.8	42°7′	73°25′30″
Tower Bk.	11.3	42°44′	72°56′

In 1995, we confirmed the presence of a large old-growth forest on Wachusett Mountain (Dunwiddie 1995; Cogbill 1996). This stand is surprising for its size, as well as for its previously overlooked location in the east-central part of the state. While detailed

Table 1. Extended.

Plot				
No.	Elev. (m)	Aspect (deg.)	Slope (deg.)	Forest Type
1	421	70	45	H-NHW
2	442	35	40	H
1	367	10	45	H
1	308	360	32	NHW
2	413	30	45	H-NHW
3	457	320	42	H-NHW
4	396	310	40	NHW
1	384	310	43	H-NHW
2	390	310	38	H-NHW
3	396	320	40	H-NHW
1	372	90	39	NHW
1	381	320	37	H
2	381	40	35	H-NHW
1	440	90	16	H-NHW
2	430	100	15	NHW
1	392	58	28	NHW
2	468	46	26	H-NHW
1	494	290	25	H
1	500	190	17	NHW
2	497	190	10	NHW
3	369	200	38	H-NHW
4	378	210	35	H-NHW
1	611	360	26	H
2	611	340	45	NHW
3	659	360	45	H-NHW
1	502	28	30	H
0	400–488	90–120	25–30	H-NHW

data on the stand have not been collected yet, our initial surveys suggest that it extends from about 420–600 m elevation on the north and east sides of the mountain, with an area of about 28 ha. The site is dominated by several forest types, including hem-

Table 2. Characteristics of old-growth stands in Massachusetts in which permanent plots have not been established. Different stands within each site are distinguished by local names. Areas are approximate. H = Hemlock, NHW = Northern hardwoods, BB = Black Birch, RO = Red Oak, RP = Red Pine, WP = White Pine, RS = Red Spruce. DEM = Mass. Department of Environmental Management, TTOR – The Trustees of Reservations, AMC = Appalachian Mountain Club.

Site Name	Size (ha)	Lat. (N)	Long. (W)
Negus	3	42°39′	72°57′
Cold River			
Todd-Clark	24	42°38′45″	72°57′30″
Wheeler Bk.	3	42°38′	72°58′45″
Upper Cold R.	3	42°38′	73°5′
Trout Bk.	3	42°37′	73°12′
Bryant Estate	3	42°30″	72°57′
Dunbar Brook			
Bear Swamp	10	42°42′	72°57′40″
Upper Dunbar	6	42°42′	72°58′45″
Ice Glen	4	42°16′20″	72°18′45″
Sages Ravine	6	42°31′	72°27′15″
Mt. Greylock			
Paris Bk./Mt. Fitch	4	42°39′	73°10′
Money Bk. tribut.	6	42°38′	73°10′
Roaring Bk.	6	42°37′	73°12′
Spruce Mtn.	4	42°42′	72°59′15″
Windsor Jams	3	42°32′	73°59′
Wachusett Mtn.	28	42°30′30″	71°53′30″
Total (Tables 1 & 2)	259.2		

lock, *Betula alleghaniensis* Britton (yellow birch), beech, other hardwoods, and *Picea rubens* Sarg. (red spruce). Ages of some of the trees have been documented in excess of 300 years (Dunwiddie 1995).

Forest composition and structure. The old-growth stands found in this study represent a spectrum of hemlock and northern hardwood forest types common in the Berkshires. These include stands dominated almost entirely by hemlock, such as Bash Bish and Mt. Greylock-Deer Hill, forests with a mixture of hemlock and northern hardwoods including yellow birch, beech, and sugar maple, and forests consisting primarily of northern hardwoods. The plot data were grouped within these three forest types for most analyses. Several sites that were documented after 1992, and

Table 2. Extended.

Elev. (m)	Aspect	Forest Type	Owner
300–500	South	NHW-RO	NE Power
240–520	Varied	H-NHW, H-BB-RO	DEM
300–390	Varied	H-NHW	DEM
360–450	Varied	H-NHW-RS	DEM
330–480	East	H-NHW	DEM
400–450	Varied	H-NHW	TTOR
330–540	Varied	NHW-RO-H	DEM
420–510	Varied	NHW, H-NHW	DEM
220–330	Varied	H-WP-RP-NHW	Laurel Hill Assoc.
330–470	North	H	DEM-AMC
450–750	Varied	H-NHW-RS	DEM
450–850	West	H-NHW-RS	DEM
480–670	Varied	H-NHW-RS	DEM
600–730	Varied	RS-NHW	DEM
425–450	Varied	H-RS	DEM
420–600	N-E	NHW-H-RO	DEM

in which no plot data were gathered, presented an unusual mixture of hemlock, *Betula lenta* L. (black birch), and *Quercus rubra* L. (northern red oak) that might be considered another forest type.

Seven plots fell within hemlock-dominated stands (Tables 3 and 4). Hemlock comprises an average of 75% of the basal area (65–90%) and 71% of the stem density. Red spruce and yellow birch are frequent but minor associates in the canopy, and *Acer pensylvanicum* L. (striped maple) is common in the subcanopy. These plots contain the highest average basal area of living trees of any of the three old-growth forest types examined in this study (42.75 m^2/ha), with a maximum value of 52.22 m^2/ha recorded at one site. Average live stem densities are also higher in the hemlock stands than in the other two forest types (480 trees/ha). The species richness of understory vascular plants is the lowest

Table 3. Average basal area and density of living and standing dead trees >10 cm dbh in seven plots in Berkshire old-growth hemlock forests.

	Live		Dead	
	BA (m^2/ha)	Density (trees/ha)	BA (m^2/ha)	Density (trees/ha)
Acer pensylvanicum	0.6	28.6	0.3	10.0
Acer rubrum	0.02	4.3		
Acer saccharum	0.1	1.4		
Betula alleghaniensis	1.9	30.0	0.2	5.7
Betula lenta	1.5	27.1		
Fagus grandifolia	0.7	11.4	0.3	4.3
Picea rubens	4.0	22.9	0.7	10.0
Pinus strobus	1.5	10.0	0.5	4.3
Quercus rubra	0.3	1.4		
Tsuga canadensis	32.1	342.9	1.4	31.4
Unknown			0.5	1.4
Total	42.8	480.0	3.9	67.1

in this forest type, with an average of 10.6 species in the 0.1 ha plots. Besides seedlings of hemlock and yellow birch, the only commonly occurring understory species is *Dryopteris carthusiana* (Vill.) H. P. Fuchs, found in 50% of the subplots.

Seven old-growth plots were placed in northern hardwood forests (Tables 5 and 6). Sugar maple is the primary species in these stands, with beech as a secondary dominant. The lowest average basal areas and stem densities occur in this forest type, but the understory species richness is high (25.3 spp./0.1 ha). The most common understory taxa include *Dryopteris carthusiana* (68%), *Arisaema triphyllum* (L.) Schott (64%), and seedlings of striped maple (54%) and beech (54%).

Twelve plots were established in hemlock-northern hardwood forests (Tables 7 and 8). This forest type is intermediate in most measures between the hemlock and northern hardwood stands; both the basal area and stem density values fall between the other two forest types. Hemlock has the highest basal area and stem densities, but beech, sugar maple, and yellow birch also are prominent in the canopy. Understory species richness averaged 15.5 spp./0.1 ha. Taxa frequently encountered in the subplots include *Dryopteris carthusiana* (79%), *Viburnum alnifolium* Marsh. (60%), *Lycopodium lucidulum* Michx. (35%), and *Oxalis acetosella* L. (33%).

Table 4. Percent frequency of understory species in old-growth hemlock forest.

	Bash Bish A2	Bash Bish B1	Cold River A4	Cold River D1	Parson-age	Grey-lock	Ever-ett
Acer pensylvanicum			25			100	
Acer rubrum					50	25	
Acer spicatum			25			25	
Acer sp.			75				
Betula alleghaniensis	100	50	25		25	25	
Betula lenta				75		25	
Dryopteris marginalis		50	50				
Dryopteris carthusiana	25	25	75		50	100	75
Fagus grandifolia			50			25	
Lycopodium lucidulum			25		50		
Mitchella repens			50				
Oxalis acetosella						100	
Picea rubens				75			
Polypodium vulgare		100			25		
Polystichum acrostichoides			50				
Prunus serotina					25		
Tsuga canadensis	100	75	25	100	75	25	100
Viburnum alnifolium			75				
No. of Vascular Species	8	10	14	7	10	16	6
Bazzania trilobata	100	25		75	50		50
Dicranum sp.	50	50			50		
Hypnum sp.	75	25			25		100
Leucobryum cf. *albidum*	25						
Leucobryum glaucum	100	75		75	25		25
Lichens		50		25			
Nowellia sp.	25						
Odontoschisma denudatum	25						
Polytrichum sp.		25		25			25
Scapania nemorosa		25					
Tetraphis pellucida		50			25		
Unidentified bryophytes	50	100	100	100	100	25	
No. of Bryophytes and Lichens	8	9	1	5	6	1	8

In all three forest types, about 50% of the trees >10 cm dbh were recorded in the canopy, with the other half classified as either overtopped or midstory. The density and basal areas of standing dead trees varied widely among all the plots. However, both the average stem density and basal area values are close to

Table 5. Average basal area and density of living and standing dead trees in northern hardwood forests. All data are from old-growth forest sites with the exception of the 22 Berkshire Continuous Forest Inventory plots (CFI); Berk = Berkshires, MA (this study; n = 7); Adir = Adirondacks, NY (Leopold et al. 1988); Bowl = The Bowl, NH; Mt. Pd = Mountain Pond, NH; Wms = Williams, NH (Leak 1987).

	Live					
	BA (m^2/ha)					
	Berk >10 cm	Adir >5 cm	CFI >13 cm	Bowl >5 cm	Mt. Pd >5 cm	Wms >5 cm
Acer pensylvanicum	0.1	0	0	1.4	0.8	0.5
Acer rubrum	0.8	0	3.4	0	0	0
Acer saccharum	21.4	30.0	6.1	10.6	15.8	6.5
Betula alleghaniensis	1.4	2.2	3.6	7.7	2.3	3.4
Betula lenta	0.2	0	0	0	0	0
Fagus grandifolia	6.8	2.0	5.1	10.3	8.4	5.8
Fraxinus americana	2.5	0	1.1	0	1.2	0.8
Ostrya virginiana	0.1	0.6	0	0	0	0
Picea rubens	0	0	0	0.4	0.3	0
Pinus strobus	0	0	0	0	0	0
Quercus rubra	0	0	1.3	0	0	0
Tsuga canadensis	0.7	2.8	1.7	0.1	0	0.9
Other	0.1	0	5.3	0.1	1.7	7.5
Total	34.1	37.6	27.7	30.6	30.6	25.3

10% of the total (living and dead) in all three forest types (Tables 3, 5, and 7).

Age estimates for selected older trees were obtained from ring counts on increment cores collected at many of the sites. These figures may underestimate the true ages by up to 50 years or so for many of the trees due to heart rot or cores not reaching the center. Some of the hemlock cores contained over 300 rings, and a few of these trees may have attained ages of 400 years or more. Fewer hardwoods were cored, but sugar maples of 200–250 years were encountered in several plots. All the plots contain trees in excess of 200–225 years, confirming the assessment that the stands were of an age to be considered old growth. A graph of the estimated ages of all the cored trees in the study plots shows a modal age of 220–240 years (Figure 1).

The size of old trees in Massachusetts old-growth stands varies greatly with the growing conditions. In many sites studied here,

Table 5. Extended.

Live			Dead			
Density (Tr/ha)			BA (m^2/ha)		Density (Tr/ha)	
Berk >10 cm	Adir >5 cm	CFI >13 cm	Berk >10 cm	Adir >5 cm	Berk >10 cm	Adir >5 cm
11.4	0	0	0	0	0	0
0	0	53.7	0	0	0	0
184.3	180	0	1.9	0.5	11.5	50
8.6	10	0	0.5	0	2.8	0
1.4	0	0	0	0	0	0
110	110	97.9	0.8	0	8.7	0
12.9	0	0	0	0	0	0
1.4	60	0	0	0	0	0
0	0	0	0	0.2	0	20
0	0	0	0	0	0	0
0	0	10.7	0	0	0	0
7.1	70	30.4	0	0	0	0
10	0	276.8	0.02	0	2.8	0
347.1	430	469.3	3.2	0.8	25.7	70

old trees were neither particularly tall nor of exceptional girth due to rigorous growing conditions, a factor which may have contributed to these stands not being cut for lumber. However, since maximum dimensions of trees frequently are of interest in comparing growth in different regions, data are included summarizing the upper size limits measured for twelve species in Massachusetts old-growth sites in the most favorable growing conditions (Table 9).

DISCUSSION

The stands identified as old growth in this study consist of later-successional species that have been undisturbed for over 200 years. If limited disturbances, such as selective cutting, occurred centuries ago, they might be difficult to detect. However, we consider any such activity at these sites unlikely to have been sig-

Table 6. Percent frequency of understory species in old-growth northern hardwood forests.

	Cold River A1	Cold River C1	Cold River E2	Dun-bar 1	Fife Bk. 1	Fife Bk. 2	Grey-lock 2
Acer pensylvanicum	25	25	50	50	100	100	25
Acer rubrum							25
Acer saccharum	50	25	25	50	75	100	
Acer spicatum	50			25			25
Acer sp.		25	75	50			
Actaea pachypoda				25		25	
Allium tricoccum			100			100	
Arisaema triphyllum			100	50	100	100	100
Aster acuminatus							75
Aster divaricatus							50
Aster sp.			50			25	
Athyrium filix-femina				50	25		
Betula lenta							25
Botrychium virginianum						25	
Carex sp.			25			25	
Caulophyllum thalictroides			100			50	
Claytonia virginica						50	
Dicentra canadensis					25	100	
Dryopteris marginalis	25		25				25
Dryopteris carthusiana	100	100	75	100			100
Erythronium americanum		25	75		100	75	
Fagus grandifolia	75	25	50	25	100	100	
Fraxinus americana			25	25	25		25
Galium triflorum						75	
Impatiens capensis						100	25
Laportea canadensis						25	
Lonicera canadensis	25						
Lycopodium lucidulum	50						100
Osmorhiza claytonii						50	
Oxalis acetosella			50				25
Panax trifolius						25	
Polygonatum pubescens		25					
Polystichum acrostichoides	50	75	75	75			
Prunus serotina			25		25		
Ranunculus sp.						25	
Ribes sp.				25			
Rubus sp.					25		
Streptopus roseus			50				
Thelypteris noveborascensis							25
Tiarella cordifolia	25			25			25
Trillium cernuum				25			
Trillium erectum	25	25	75		25	25	

Table 6. Continued.

	Cold River A1	Cold River C1	Cold River E2	Dun-bar 1	Fife Bk. 1	Fife Bk. 2	Grey-lock 2
Tsuga canadensis			25				
Viburnum acerifolium					25		
Viburnum alnifolium	75	75		50			100
Viola canadensis						100	
Viola rotundifolia	50	25			50	25	25
Viola sp.				25	25	75	25
No. of Vascular Species	16	18	29	20	30	38	26
Bazzania trilobata	25						
Dicranum sp.	25		25				
Unidentified bryophytes	25	50	50	75	25	75	100
No. of Bryophytes	3	1	2	1	1	1	1

nificant. Although settlements existed in Berkshire County in the mid-1700s, forest cutting at that time would have focused on clearing the better agricultural land and on harvesting high quality timber, especially spruce and pine, in accessible locations. While factors such as steep slopes, remoteness from logging roads, and lesser quality wood combined to favor the survival of these remnants of old growth, chance no doubt contributed as well.

This survey of old-growth forest in Massachusetts emphasizes its extreme rarity in the state. After more than 300 years of intensive land clearance, agriculture, forestry, and development, only about thirty documented sites remain. Furthermore, these scattered remnants are small patches in a matrix of regrowth forest. The largest old-growth site is only about 28 ha, considerably smaller than the stands of several thousand hectares in the Adirondacks of New York (Leopold et al. 1988) and the White Mountains of New Hampshire (Leak 1987).

Data from some other New England old-growth forests are presented in Tables 5 and 7 for comparison. In addition, data are included from selected Continuous Forest Inventory (CFI) sites in Massachusetts (W. Rivers, Massachusetts Department of Environmental Management, pers. comm.). These variable-radius tree plots are located every half mile on most state lands in the Berkshires. Data included in the tables come from all the CFI plots in the vicinity of the old-growth stands (generally sites with-

Table 7. Average basal area and density of living and standing dead trees in hemlock-northern hardwood forests. All data are from old-growth forest sites with the exception of the 22 Berkshire Continuous Forest Inventory plots (CFI); Berk = Berkshires, MA (this study; n = 12); Adir = Adirondacks, NY (Leopold et al. 1988).

	Live		
	BA (m^2/ha)		
	Berk >10 cm	Adir >5 cm	CFI >13 cm
Acer pensylvanicum	0.2	0.5	0.0
Acer rubrum	0.0	0.0	7.1
Acer saccharum	4.6	3.2	0.2
Betula alleghaniensis	3.6	0.0	4.4
Betula lenta	0.3	0.0	0.0
Fagus grandifolia	5.8	5.5	2.2
Fraxinus americana	0.2	0.0	0.0
Ostrya virginiana	0.01	0.0	0.0
Picea rubens	0.3	2.2	0.0
Pinus strobus	0.0	0.0	1.8
Quercus rubra	1.6	0.0	0.7
Tsuga canadensis	20.5	30.9	14.1
Other	0.3	0.0	4.6
Total	37.4	42.3	35.2

in the same valley) that were from the same forest types. These figures provide comparative data for second growth hemlock-northern hardwood and northern hardwood forest types; no CFI data were available for the hemlock forest type. It is important to note, however, that due to the small sample sizes and non-random placement of plots in the Berkshire old-growth stands, differences between these data sets should be considered only as general trends. In addition, different authors used different minimum diameters, which also limits data comparability.

The hemlock old-growth stands in the Berkshires (Table 3) had a similar total basal area (42.8 m^2/ha) to that reported by G. Whitney from Heart's Content, Pennsylvania (42.4 m^2/ha), and an old-growth hemlock-yellow birch forest in New Hampshire (Tritton and Siccama 1990). Heart's Content had a lower stem density (366 stems/ha) than the average from the Berkshire sites (480 stems/ha). Standing dead stems in the Berkshire old-growth hemlock forests represented 8% of the total basal area, and 12% of

Table 7. Extended.

Live			Dead			
Density (Tr/ha)			BA (m^2/ha)		Density (Tr/ha)	
Berk >10 cm	Adir >5 cm	CFI >13 cm	Berk >10 cm	Adir >5 cm	Berk >10 cm	Adir >5 cm
10.8	93.0	0.0	0.1	0.1	6.7	18.0
0.0	0.0	119.7	0.0	0.0	0.0	0.0
61.7	25.0	0.0	0.4	0.3	5.8	3.0
46.7	0.0	0.0	0.0	3.2	0.0	15.0
10.8	0.0	0.0	0.1	0.0	1.7	0.0
109.2	238.0	41.2	1.2	1.4	15.8	23.0
1.7	0.0	0.0	0.03	0.0	0.8	0.0
0.8	0.0	0.0	0.0	0.0	0.0	0.0
1.7	28.0	0.0	0.0	0.9	0.0	15.0
0.0	0.0	12.3	0.0	0.0	0.0	0.0
4.2	0.0	14.5	0.0	0.0	0.0	0.0
163.3	240.0	328.3	2.6	4.2	11.7	25.0
5.0	0.0	204.2	0.04	0.2	1.7	3.0
415.8	622.0	720.2	4.5	10.4	44.7	102.0

the density. These values closely match those reported by Tritton and Siccama (1990) for this forest type (8 and 9%, respectively).

Data from northern hardwood forests in New England are compared in Table 5. Basal areas of old growth in Massachusetts are similar to values from the Adirondacks and New Hampshire, but averaged about 23% higher than in the CFI second growth plots. Although somewhat different minimum stem diameters were used in different studies, stem densities were higher in the Adirondacks and in the CFI plots than in the Berkshire old growth; this pattern also was observed in the hemlock-northern hardwood types (Table 7). Standing dead stems in the Berkshire old-growth northern hardwood forests represented 8% of the total basal area, and 7% of the stem density, less than the average of figures reported by Tritton and Siccama (1990) for this forest type in New Hampshire and Vermont (12% of the total basal area, 13% of the total stem density).

Average live basal areas in the twelve hemlock-northern hard-

Table 8. Percent frequency of understory species in hemlock-northern hardwood old-growth.

	Bash Bish	Cold River	
	A1	A2	A3
Acer pensylvanicum		25	
Acer saccharum			25
Acer spicatum		50	
Acer sp.			25
Aralia nudicaulis	25	25	
Arisaema triphyllum			
Aster sp.			
Betula alleghaniensis	50		
Betula lenta	25		
Carex sp.			
Clintonia borealis		25	
Dryopteris marginalis			
Dryopteris carthusiana	100	100	
Erythronium americanum			
Fagus grandifolia		75	
Fraxinus americana			
Gymnocarpium dryopteris			
Kalmia latifolia			25
Lycopodium lucidulum	25	75	
Maianthemum canadense			
Mitchella repens		25	
Oxalis acetosella	100	25	
Picea rubens			
Polypodium vulgare		25	
Polystichum acrostichoides		25	
Prunus serotina			
Rubus sp.			
Sambucus sp.			
Streptopus roseus			
Taxus canadensis			
Trientalis borealis			
Tsuga canadensis	50	25	
Viburnum acerifolium			
Viburnum alnifolium	50	100	
No. of Vascular Species	8	21	6
Atrichum undulatum			
Bazzania trilobata	25		
Dicranum sp.			
Hypnum sp.	100		
Tetraphis pellucida	25		
Thuidium delicatulum			
Unidentified bryophytes	100	50	100
No. of Bryophytes	5	1	1

Table 8. Extended.

Cold River					Dunbar	Fife Bk.		Grey-lock
B1	B2	B3	D2	E1	2	3	4	3
	25	75		25		75	50	50
		25		25		75	25	
			25	25				25
			100	100		25	50	
							100	
		25	25	100				
						25	25	
		25				50		
							75	
						25		
25								
75	100	100	100	100	100	50	25	100
				100				
	50	25		50		25	50	25
				75				
			50					
	75	25	25		100			100
				25				
		25	75	100				75
								25
	25	50	25		25	25		
				25				
				25		25		
				25		25		
			25					
	25							
							50	
					50		25	
						50	50	
50	75	100	75	75	100		25	75
10	9	15	13	32	11	23	17	21
		25	50			25		
							25	
				25		25		
75	75		75	75	50	100	100	75
1	1	1	5	3	1	4	2	1

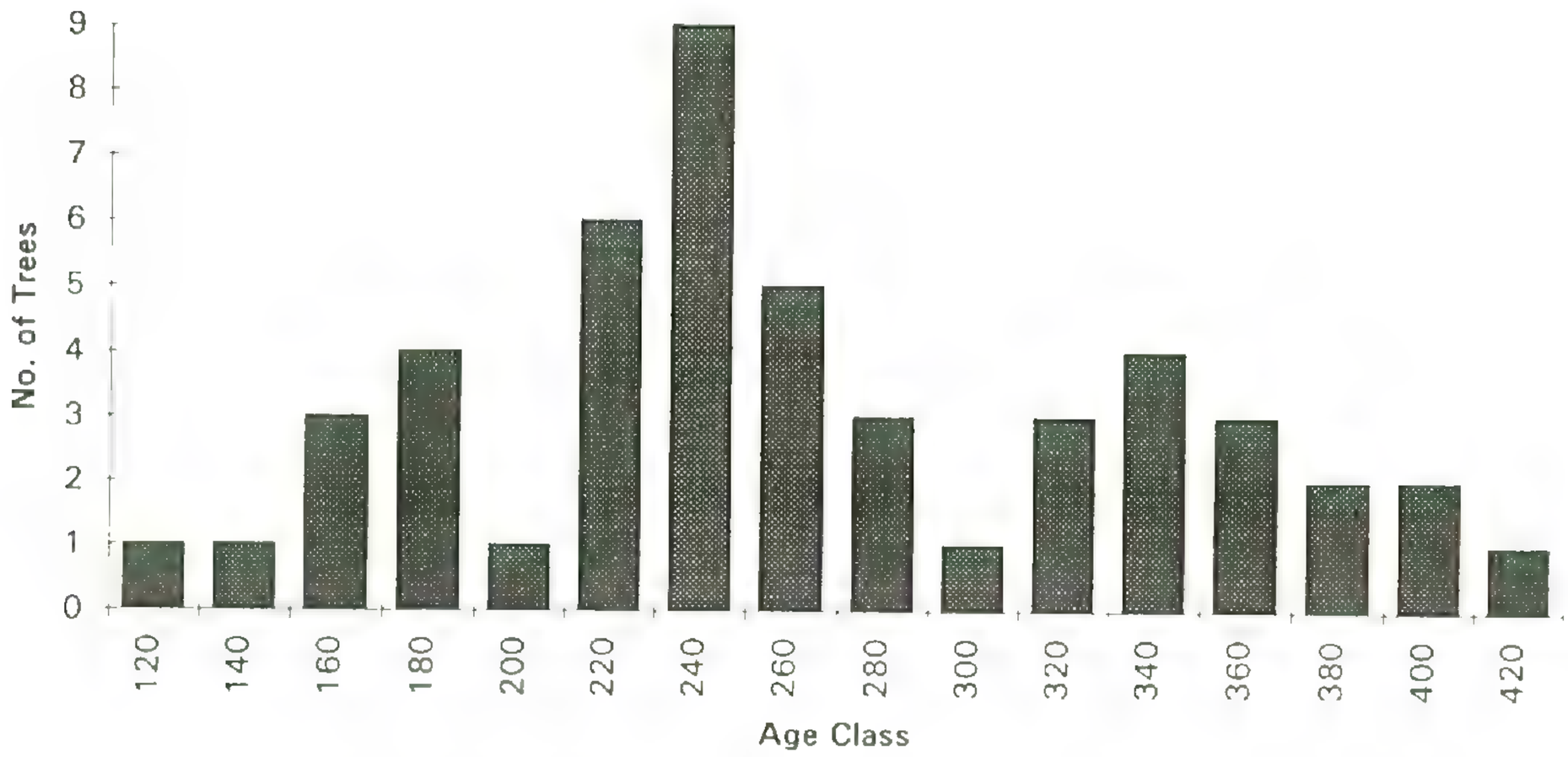

Figure 1. Distribution of ages of old trees in the study plots, determined by ring counts on increment cores and estimates of additional rings to tree center.

wood plots sampled within old-growth forests in the Berkshires are about 10% lower than in the Adirondack sites (Table 7), many of which appear to be in richer soils and on more level ground (pers. obs.). The CFI plot live basal areas are very similar to the nearby old-growth stands. However, live stem densities are nearly twice as high in the CFI sites. Stem densities are also 50% higher

Table 9. Maximum tree sizes in old-growth stands. Absolute maxima represent the greatest values found over all sites. The maximum diameters and heights for a species seldom apply to the same tree. The average maxima apply to sites exhibiting favorable growing conditions. All units are in meters.

Species	Absolute Maximum Diameter	Absolute Maximum Height	Average Maximum Diameter	Average Maximum Height
Acer saccharum	1.26	41.0	0.97	33.5
Acer rubrum	0.99	32.9	0.77	28.1
Acer pensylvanicum	0.34	18.0	0.19	11.6
Betula alleghaniensis	1.24	29.9	1.02	27.1
Betula lenta	1.00	33.2	0.74	26.2
Fagus grandifolia	0.98	35.7	0.81	31.4
Fraxinus americana	1.35	39.3	1.01	35.1
Picea rubens	0.78	39.0	0.60	31.7
Pinus strobus	1.24	46.5	0.95	38.7
Prunus serotina	0.90	34.2	0.70	29.5
Tilia americana	0.85	35.1	0.68	30.1
Tsuga canadensis	1.30	41.2	1.04	34.2

Table 10. Average basal area and density of large trees (>35 cm dbh) in Berkshire old-growth forests.

	BA (m^2/ha)	% of Total BA	Density (Trees/ha)	% of Total Density
Hemlock	30.9	72	159	33
Hemlock-Northern Hardwood	27.8	74	114	27
Northern Hardwood	26.6	78	99	29

in the Adirondack old-growth sites than in the Berkshires. The composition of all these sites is similar, with the exception of red maple instead of sugar maple in the second growth CFI plots. The basal area and density of standing dead trees in this forest type were similar to both the hemlock and northern hardwood types (10–11% of the total), but considerably less than values reported from the Adirondacks by Leopold et al. (1988). Understory species composition was similar in old-growth hemlock-northern hardwood stands from both the Berkshires and Adirondacks, with *Dryopteris carthusiana* a common dominant herb. Species richness was also similar to the Adirondacks (15.8 vs. 17.3 spp./0.1 ha).

The density of old trees in Massachusetts old-growth forests varies widely both within and between sites. Individuals are often highly clumped, and large areas may have few old trees. Data on the denser, more clumped areas of this old tree distribution can be extracted from the study plots, which were chosen to characterize areas with higher densities of large and generally old trees. Large trees, arbitrarily defined here to include individuals >35 cm dbh, have an average density of 120 trees/ha in the 26 old-growth plots (Table 10). The lowest density occurs in northern hardwood stands (99 trees/ha); hemlock stands have the highest (159 trees/ha). These trees comprise an average of about one-third of the stems, but three-fourths of the basal area. In the western Adirondacks, similar statistics are available in historical reports from uncut hardwood forests (cited in Leopold et al. 1988). Average densities of "sound" canopy trees (>25.4 cm dbh) were reported at 195 (Graves 1899) and 211 stems/ha (McCarthy and Belyea 1920). Values from the Berkshire plots using this lower minimum size cutoff are 186 stems/ha for the plots in hemlock-

northern hardwood forest types, and 147 stems/ha for northern hardwoods.

Comparisons of these data suggest that the Massachusetts old-growth forests may have lower average densities of large trees than what was typical in similar forest types in the Adirondacks. These lower values in the Berkshires may result from a number of causes, including (1) slower growth rates, (2) a larger average size for the big trees, which generally is correlated with a lower average density, (3) higher probability of tree fall or other mortality in large trees, or (4) differences in sampling methods. The first and third explanations appear to be most likely, but future research should be directed towards this question for two reasons. First, the delineations of old-growth forests could be quite different, depending on what minimum density of old trees is included. Thus, determinations of the area of old growth in the state could vary considerably on this basis alone. Second, the nature of disturbances and gaps in these forests is not well understood. Viable old-growth ecosystems must include areas big enough to accommodate the scale of disturbances characteristic of these stands. It is not yet clear how large these disturbances typically are in the Massachusetts forests.

The data presented here help identify old-growth forest types that appear to be absent from the state today, but which may have occurred in the past. Notably, *Pinus strobus* L. (white pine) is missing from nearly all the old-growth stands. This species was prized by early loggers, and most stands that included significant numbers of large trees almost certainly would have been cut quickly (Pike 1967). White pine also tends to be an early-successional species and is more prone to wind damage than hemlock; thus it is less likely to persist in great numbers in many later-successional forests. Old northern hardwood stands also are relatively uncommon. These were cut for fuel, potash, and lumber (Pike 1967), and, like the white pines, the hardwoods tend to be more prone to breakage and windthrow than the hemlocks. Thus, the probability of a stand of hardwoods reaching 250–300 years with most of its canopy trees intact approaches zero in this area. Old-growth stands of any type on level ground also are scarce. Such sites generally would have been quite accessible, and hence were likely to have been cut.

No vascular plant taxa were found that were unique to the old-growth sites. The only taxon included in the list of rare species

tracked by the Massachusetts Natural Heritage and Endangered Species Program that was seen occasionally was *Ribes lacustre* (Pers.) Poiret (Special Concern). This species also was observed in forests that were not old growth. However, other groups of organisms that were not examined extensively, including fungi, lichens, bryophytes, and invertebrates that inhabit the canopy, bark, rotted wood, and soil, may have taxa that are found primarily in old-growth habitats. For example, recent studies by Cooper-Ellis (1994), in several of the Massachusetts sites identified in this study, noted 24 bryophyte species that occurred exclusively in old-growth forests. Various characteristics of the forest floor, including accumulations of rotted wood, microtopography such as tip-up mounds and pits, and the development of soil horizons, may also reveal some unique qualities in the old-growth sites. Whitbeck (1995) reported significantly higher amounts of woody debris in the Massachusetts old-growth hardwood stands he studied than in second growth forests. Future research should focus on these poorly understood aspects of old-growth forests.

The criteria we used to identify old-growth forests were adequate for providing a first approximation of the minimum extent and distribution of old-growth forest in Massachusetts. However, these criteria clearly excluded areas within old-growth ecosystems where widespread blowdowns and other disturbance processes eliminated most of the old trees. Since disturbance is certainly a component of healthy old-growth ecosystems, future work is needed to develop criteria that more adequately incorporate disturbance processes in definitions of these forests types, and to quantify the range of densities of old trees characteristic of different old-growth forest types.

The methods we employed to quantify most parameters were insufficient to provide statistically valid descriptions of each stand. A much larger number of randomly placed plots would be needed to adequately characterize most of the sites we visited. An expanded array of plots would not only provide a more accurate description of the various components of the stands, but also would serve as an excellent basis for evaluating future changes in these forests.

Only about 30 old-growth stands are known in Massachusetts, with a total area of approximately 257 ha. The extremely small size of these stands, together with their small number, emphasizes

the importance in preserving these few fragments that remain of the original forest that once covered much of the state. Efforts can be made to ensure that these stands are not lost to human activities in the future; however, these stands can, and will, eventually fall to storms and other natural disturbances. The loss of large areas of several old-growth stands within the last few decades in the Northeast due to windthrow testifies to the ephemeral nature of this resource. Clearly, if forests that capture many of the attributes and characteristics of old-growth stands are to be conserved into the future, protection efforts must include more than the small fragments that remain. Preservation of old-growth forest in Massachusetts will require the establishment of reserves of sufficient size to accommodate natural processes of disturbance and regeneration.

ACKNOWLEDGMENTS. This study was supported by contracts with the Massachusetts Natural Heritage and Endangered Species Program, for which we are extremely grateful. Field assistance was provided by Jeanne Anderson, Karen Harper, Sarah Cooper-Ellis, Sarah Jennings, William Dunwiddie, Rob Leverett, Jr., and Phil Robakievicz. Bill Rivers provided the CFI plot data. Charlie Cogbill contributed much to the methodological and definitional portions of this work. We also thank Pat Swain, Bill Patterson, David Foster, Jack Lash, and the many foresters and staff of the Massachusetts Department of Environmental Management, who assisted in many ways with this work.

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RHODORA, Vol. 98, No. 896, pp. 445–458, 1996

COMMENTS ON THE OCCASION OF THE CENTENARY OF THE NEW ENGLAND BOTANICAL CLUB[1]

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In December 1895, William G. Farlow wrote to a number of friends suggesting a meeting at his home on Quincy Street in Cambridge to discuss the formation of a botanical club. A second meeting agreed to such an organization, and at a third meeting on February 5, 1896, the New England Botanical Club was officially founded with seven professional botanists and ten amateur botanists as the charter members. We have no record of others who might have been invited or whether there were refusals. At the fourth meeting in March 1896, Messrs. Fernald, Fuller, Greenman, Jack, John Robinson, and Rich from Boston were elected members; Sears and Bailey from Providence and Jackson from Worcester became the first nonresident members. Since Fernald was a student at the time, he became the first student member of the NEBC.

With some knowledge of organizations then active, I have wondered why the New England Botanical Club was organized. Asa Gray had died in 1888 and Louis Agassiz before him, so there was no leader in the natural sciences in the Boston area. Sereno Watson, Gray's immediate successor at the Botanic Garden, and his successor, Benjamin Robinson, had no major impact in Boston science or society. Charles Sargent was concerned only with the Arnold Arboretum. The Darwin controversy had subsided in the Boston area. Farlow, Gray's protégé for nonvascular plant collections, was outshone by George Goodale, who handled Gray's teaching chores and areas of physiology, morphology, and, eventually, economic botany. Both Farlow and Goodale had separated their activities and collections from the Botanic Garden and the herbarium, creating their own departments at the Agassiz

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[1] The following is derived from the remarks delivered to The New England Botanical Club at its Centennial Banquet on November 1, 1996. Readers interested in more information about the history of the Club and its founding members should refer to Dr. Howard's paper "A partial history of The New England Botanical Club," published in *Rhodora* 75: 493–516 (1973).—*Ed.*

Museum in the campus area in Cambridge. Since Goodale was a better speaker and a more successful fundraiser for the more appealing collections he curated, he was better known in the Boston area. He was one of the charter members of the NEBC.

The oldest of the learned societies in America was the American Philosophical Society, founded in Philadelphia in 1771. The American Academy of Arts and Sciences was organized in 1780. Asa Gray was an active member after his arrival in the Boston area in 1842. He served as president for 10 years (1863–1873) and published frequently in the *Proceedings* of the Academy. In 1791 the Massachusetts Historical Society was founded, the earliest in the United States, and the following year, 1792, the Massachusetts Society for Promoting Agriculture was organized. The Boston area botanists were not involved in either of these.

Other learned societies in New England were represented by athenaeums, Linnaean societies, lyceums, natural history societies, horticultural societies, and scientific clubs. I want to comment briefly on each group.

ATHENAEUMS

The Athenaeum was "an institution or society for the promotion of literary and/or scientific learning." The first one in New England was founded in 1753 in Providence, Rhode Island. The Boston Athenaeum, founded in 1807, was to have "a reading room, a library, a museum, and a laboratory." It remains active as a membership organization to this day. The "museum and a laboratory" were never developed, but an art collection begun in 1827 preceded the Boston Museum of Fine Arts by 43 years.

LINNAEAN SOCIETIES

The Linnaean Society of London was founded in 1788. Similarly named societies with comparable interests developed worldwide, but without official linkage to the London group. In 1815, the New England Society for the Promotion of Natural History changed its name to the Linnaean Society of New England. This was dissolved in 1823 but re-established seven years later in 1830 as the Boston Society of Natural History. Later it was renamed the Boston Museum of Natural History and maintained its headquarters, museum, library, series of publications, and an active

program until 1941. It then became the Museum of Science, disposing of its collections and the Berkeley Street building in favor of new quarters and programs in its present location on the Charles River Dam.

During its most active period the Boston Museum of Natural History offered the free Lowell lectures, for which George Goodale was a speaker six times. The Museum's Teacher's School of Science was instrumental in early teaching of natural history in Boston schools. Farlow gave "botany lectures" in the series, and Goodale gave "a comprehensive course of twenty-one lectures on morphological, physiological, and systematic botany to an audience averaging 120 students." Goodale introduced the technique of printed synopses of his lectures, which developed into the published *Guides for Science Teaching*. He supplied dried as well as fresh specimens in sets for the students to use in their teaching. A survey of Massachusetts plants was requested by the Commonwealth of Massachusetts, and the resulting work by Prof. Chester Dewey of the Berkshire Medical Institute (herbaceous plants) and George Emerson (trees and shrubs) was published by the Society between 1839 and 1846. Walker prizes for essays on designated themes or topics in science were offered between 1864 and 1876 and continued in recent years by the Museum of Science as awards for outstanding scientists, especially local Nobel prize winners.

The Linnaean Society of New York was founded in 1878 and continues to the present with the name intact. The organization's primary interest is in "natural science, conservation, especially ornithology, including sponsored field trips." It is open to amateurs and professionals.

LYCEUMS

Lyceums were created "in remembrance of the school founded by that sublime genius, Aristotle, at Athens." Originally, they were debating societies or discussion groups for the "dissemination of useful knowledge." There is an estimate that 3,000 lyceum programs existed at one time. The Lyceum of Natural History of New York was founded in 1817. In 1833 John Torrey was a member, and in 1835 Torrey's associate, Asa Gray, was appointed curator of the Lyceum's botanical collections. In Massachusetts there was a lyceum in Worcester in 1825 which has

been renamed many times: the American Lyceum of Science and Arts for Worcester County (1826), the Worcester County Lyceum (1829), the Lyceum and Library Association (1866), the Worcester Natural History Society (1884), and the Worcester Science Center, before becoming the New England Science Center in 1986. In the decade between 1829 and 1838 there were active Lyceums in Millbury, Littleton, Shrewsbury, Marlborough, Petersham, Barre, and at Williams College. The Littleton Lyceum remains active to the present, no longer presenting mainly lectures, debates, and discussions, but now offering also programs of music, mime, and drama. A cadre of speakers developed that moved from city to city presenting programs at local lyceums. Henry David Thoreau was the most noteworthy of the naturalists on the lecture circuit. No members of the future NEBC appear on program lists available. The Chautauqua Library and Scientific Society, organized in 1878 in New York state, essentially represented a travelling lyceum program.

HORTICULTURAL SOCIETIES

The New York Horticultural Society was incorporated in 1822, and the Pennsylvania Horticultural Society was organized in 1827 and chartered in 1831. The Massachusetts Horticultural Society, founded in 1829, offered a very active and diverse program before the founding of the NEBC. Flower shows were at various times offered weekly, and lectures were scheduled regularly. The Harvard Botanic Garden (with contributions from Asa Gray), the Bussey Institution (with contributions from Jackson Dawson), Charles Sargent, and, later, the Arnold Arboretum were strong supporters and exhibitors. In 1877 the Massachusetts Horticultural Society began a scientific lecture series. Assistant Professor George Goodale told of poet Goethe's conclusions that parts of flowers were modified leaves. The records also report that Darwin and his writings were discussed, and surprise was expressed that Goodale differed from Darwin on many points. B. D. Halsted of the Bussey Institution talked on injurious fungi, Rev. J. V. Russell lectured on cryptogamic botany, and William Farlow talked on diseases of forest trees. In 1841, before coming to Harvard, Asa Gray presented a talk and was elected a corresponding member. He was listed as "professor of botany and plant physiology" at the Society in 1860–62, although it is noted: "His interest lay in

scientific study rather than cultivation and he has been of great service to the library." Charles Sargent was listed as professor of botany in 1891–92.

NATURAL HISTORY SOCIETIES

There were many active natural history societies in New England. The Providence (Rhode Island) Franklin Society was formed in 1821, held weekly meetings, and in 1877 established a botanical section to create a catalogue of Rhode Island plants. The secretary recorded that "a feature of the meetings so far has been the attendance of a number of ladies and we can safely affirm an increasing interest in our beloved science in this community."

Essex County had a Natural History Society (1833) and the Essex Institute (1834); the two merged in 1848 and created departments of natural history, history, and horticulture. Flower shows were held regularly, especially exhibitions of vegetables. In 1854 J. F. Allen had a fine garden in Salem and must have had greenhouses, for he published an elaborate elephant folio on *Victoria regia,* which had been brought into flower. George Peabody was born in Danvers, Massachusetts, in 1795. He amassed a fortune in Anglo-European trade and made generous gifts to New England. In 1853 he made a gift of $100,000 to Yale, where his nephew was the paleontologist, Prof. Marsh. In 1862 Peabody promised Harvard President Edward Everett $100,000 in support of astronomy and art, but the local scientific circles "helped direct" this gift to the design of a museum of archeology and anthropology. Peabody died in 1867, leaving a bequest of $140,000 to support the study of natural history in Essex County. The Peabody Academy of Sciences was formed in 1868 with this money and with Asa Gray as one of its trustees. Its publications had few articles on botany. The outstanding were Robinson's lists of ferns of North America north of Mexico, later revised by D. C. Eaton, and an article on the strength and fuel value of native woods, which Robinson had extracted from Sargent's report on the forests of North America. The lecture series and courses at the Peabody Academy featured offerings in botany by Goodale, Robinson, John Sears, C. E. Bessey, and D. P. Penhallow. Between 1876 and 1881 the Academy offered a Summer School in Biology patterned after Agassiz's school on Penikese Island. Dr. Packard of

Peabody was the director, and John Robinson, Goodale, Penhallow, and Bessey were the instructors. In 1880 the Academy decided not to compete with the Boston Museum of Natural History or the Museum of Comparative Zoology in acquiring general collections, but to concentrate on works of man and the flora and fauna of Essex County. In 1922 the complex was renamed the Peabody-Essex Museum. An herbarium is maintained to the present.

In 1834 the Yale Institute of Natural Sciences was formed and was to become the Yale Natural History Society. The Natural History Society of Hartford (1835) became, in 1845, the Connecticut Society of Natural History. The Maine Institute of Natural History (1836) became the Portland Society of Natural History (1843). The Cuvierian Society of Wesleyan University was alternately known as the Natural History Society of Wesleyan University. In Cambridge, Massachusetts, students organized the Harvard Natural History Society in 1837, creating a cabinet and housing specimens in Massachusetts Hall. Asa Gray lectured to this group on April 18, 1878, on forest geography and archeology. Benjamin Watson, later a charter member of the NEBC, was a member when a student at Harvard. Little more has been located of this club or its collections.

Other natural history groups were formed in Lynn, Massachusetts (1842), Concord, New Hampshire (1846), and Springfield, Massachusetts (1859); other similar organizations were the Boston Amateur Scientific Society (1877), Middlesex Field Club (1881), Natural History Club of West Roxbury (1882), Natural History Club of Boxford, Massachusetts (1882), and the Newport Natural History Society of Rhode Island (1883).

Perhaps the most ambitious amateur natural history undertaking was the Agassiz Association, developed in 1875 by Harlan Hage Ballard of the Lenox Academy in western Massachusetts. The Association was formed while Louis Agassiz was alive, and with his permission. To encourage the study, discussion, collection, and exchange of natural history objects, Ballard encouraged the formation of chapters. Four people could form a chapter and name it. They could be of the same sex or age, as adults, families, or children. At its peak the Association had 1200 "chapters" of 4 to 120 members, with a total of 20,000 members in the United States, Canada, England, Ireland, France, Chile, New Zealand, and Japan! Chapters had meetings, conducted field trips, ex-

changed artifacts, and published newsletters. Correspondence with Ballard was encouraged, and he would redirect the letter to a specialist for a personal reply and future contact. With permission, specimens or artifacts could be submitted for identification, at which time the enclosure of five two-cent stamps to cover postage was requested. An Association pin was available through the manufacturer, who would supply a price list. A chapter certificate was priced at 75 cents. A handbook of the Agassiz Association called *Three Kingdoms* was published in at least four editions. The fourth, in 1897, mentioned need for an endowment to maintain the organization with a paid staff, but I can find no reference to dues or of payment to Ballard. Ballard maintained contact with scientists in several countries to help answer questions submitted or to conduct correspondence courses. Marcus Jones, E. L. French, W. O. Crosby, Alexander Wight, W. Whitman Bailey, William B. Werthner, John Davis, Jacob Bigelow, and Francis Gay were among the specialists who cooperated with identifications, and who offered correspondence courses. In 1887 the Asa Gray Memorial Botanical Chapter was formed, which eventually had five geographic divisions and a total membership of 44. The chapter issued a publication which became the *Asa Gray Bulletin,* as well as *Reports* and the *Observer.* Also in 1887 there is casual mention of the Asa Gray Botanical Club in Utica, New York, which purchased the Hunt Herbarium and gave it to the Oneida Historical Society. The Linnaean Fern Chapter was also a spinoff of the Agassiz Association in 1893. This group eventually became the American Fern Society and later spawned the Bryological Society.

SCIENTIFIC CLUBS

In 1854 Asa Gray assembled his scientific colleagues, mostly all professors, to regular meetings for professional discussions. No records of a club have been located.

The most successful and longest lasting of the scientific clubs is certainly the Torrey Botanical Club of New York. It began in 1867 with informal meetings with Dr. Torrey. When William H. Leggett compiled a modest four-page monthly news sheet, he named it the *Bulletin of the Torrey Botanical Club,* and the name was adopted. The *Bulletin* became the first botanical periodical in America, and was dedicated to the study of the flora of the

New York City area. There followed a series of noteworthy contributions. In 1873 a *Botanical Directory of North America* was the first such publication. In 1886 the *Index to Recent American Botanical Literature* began under the editorship of Elizabeth Britton and Frederick Merrill. It also appeared as a card index in 1890 but was stopped by the Club in 1996 and is being continued in *Brittonia* by editors at the New York Botanical Garden. The *Memoirs of the Torrey Botanical Club* met the need, in 1889, for a regular series of publications in monographic form. The first number had an article by Liberty Hyde Bailey entitled "Studies of types of various species of *Carex*." In 1901 *Torreya* was created to handle brief communications and those of a popular character. This was combined with the *Bulletin* in 1946. Beginning in 1997 the Torrey Botanical Club will be renamed a Society and the *Bulletin* will become the *Journal of the Torrey Botanical Society*.

Sometime in the 1870s "a few ladies of this city (Syracuse, New York) have formed a club named the Rust Botanical Club, of which Mrs. Rust has been elected president. At first we shall make the study of ferns our specialty, hoping afterwards to study general botany." In 1879 it is reported that the president objected to the eponym, and it was changed to the Syracuse Botanical Club. The Club was "exclusively" for ladies. Numbering 32, they had field meetings twice a week in season, weekly meetings for study, and a business meeting on the third Monday of each month. The Club reported regularly in the *Bulletin of the Torrey Botanical Club* and by correspondence to Cambridge botanists Gray, Eaton, Peck, Robinson, and Davenport. They were proud of tracing the routes of Frederick Pursh and rediscovering *Scolopendrium*. In 1912 *A Flora of Onondaga County as Collected by the Members of the Syracuse Botanical Club* was published. A photograph in the Gray Herbarium archives shows the group of ladies in the field on July 16, 1915. The demise of the Club is not known.

In 1874 there was a Connecticut Valley Botanical Society which had "a very animated meeting at Mt. Holyoke Seminary Wednesday, June 10th." At a meeting on October 6, 1875, Professor Asa Gray was in attendance.

The American Botanical Club was formed in 1883 by members of the American Association of Arts and Sciences for the study of plants by correspondence. In 1892 this became the Botanical

Society of America, which "limited its membership to those who have published worthy work and are actively engaged in botanical investigations."

Eighteen ninety-five proved to be an exceptional year for the formation of botanical clubs. On July 4th a group gathered to explore a mountain plateau in Vermont and to form an association which became the Vermont Botanical Club. Ezra Brainerd of Middlebury and L. R. Jones of Burlington were Vermont residents. Summer visitors included Rev. James A. Bates of South Royalston, Massachusetts, and Marshall Howe, W. W. Eggleston, and A. J. Grout of New York City. Cyrus Pringle and George Perkins of Burlington joined immediately, as did Barnhart of New York. The group planned one summer meeting for a field trip and one winter meeting for papers. Between 1906 and 1914 the Club published a *Bulletin.* Fernald wrote an article "Some Northern Plants Possibly to be Found in Vermont" for the third bulletin, issued in 1908.

On July 12 another group of amateur botanists assembled in Portland, Maine, to organize a botanical club. Asa L. Lane was the first president; Kate Furbish, then 61, was elected vice president, and Merritt Fernald was the first recording secretary. It was Fernald who proposed the name Josselyn Botanical Society to honor *John Josselyn's Rarities,* the first written account of the Maine flora. It was suggested that "Club" was an overworked title; hence the name Josselyn Botanical Society of Maine was adopted. This group has published a *Bulletin* at irregular intervals, the last being Number 13 in 1995.

There is no clear answer to the question of why the New England Botanical Club was proposed in 1895 and organized in 1896. There were active organizations in the Boston area involving both professional and amateur botanists. Not all clubs admitted women, and the NEBC began as a gentlemen's organization. Charter members comprised seven professional botanists and ten amateurs. Brief biographies of them are supplied in previous articles cited in the closing suggestions for additional reading. The group had little in common socially, and varied in professional roles. Nevertheless, the Club flourished for a century, and shows no signs of weakening in its goals or accomplishments.

TRIVIA FROM THE NEBC'S FIRST HUNDRED YEARS

M. L. Fernald was the first student member of the NEBC, being elected at the fourth meeting in 1896. He edited *Rhodora* for 23 years. When he died in 1950 he had been an active Club member for 54 years.

David Pearce Penhallow of McGill University was possibly the first foreign member of the Club, having joined November 6, 1896.

Mary Day, librarian of the Gray Herbarium, published in volume 3 of *Rhodora,* in 1901, a list of 66 private herbaria and a list of 258 local floras as an aid to Robinson in compiling distribution data for the 7th edition of *Gray's Manual.*

The choice of *Rhodora* for the title of the Club's publication was to indicate a primary interest in plants of the same range. Initially, Club members were to concentrate on plants of the Boston region and of the mountains in New England.

Advertisements in *Rhodora* in 1902 drew published criticism from other botanical journals and had to be defended in editorials. The advertisements by the Bangor and Aroostook Railroad stated, "If you are looking for the Best Botanizing in the eastern states, you should save up pennies enough to visit The Aroostook." Among the plants which could be collected easily was *Pedicularis furbishii,* which in recent years was declared to be an endangered species. The editor replied: "Indeed the flora of no other area east of the Rocky Mountains and south of British America seems to us less in need of concealment or special protection."

The NEBC may well be the first to drop page charges to its publication on January 27, 1996.

The NEBC herbarium was started immediately upon the Club's organization. For years it was fumigated with carbon bisulfide, fortunately with no casualties. This dangerous, poisonous, and flammable chemical was proposed for insect control in the *Bulletin de la Société Botanique de France* in 1877.

In 1996 an agreement was made to integrate the NEBC herbarium with the general collections of the Harvard University Herbaria. Currently the NEBC records 251,000 specimens.

Fellowship prizes were offered by the NEBC for the first time in 1985.

For many years candidates for admission were nominated and supported by statements to the membership. "Scrutineers" were appointed and written votes counted and reported. When there were negative votes one such blackball disqualified the candidate.

Women were elected to the Club for the first time on December 6, 1968. Alice Tryon was the first woman elected and the first to serve as President of the NEBC in 1978.

The early meetings of the Club were held in members' homes and subsequently at Young's Hotel and the Twentieth Century Club, and fancy meals were served. Pease reported: "Ample collation—e.g., chicken croquettes, cold joints, salads, escalloped oysters, and ice cream replenished by one or two bustling waiters." With food supplies limited during World War I, the refreshments dropped to crackers and cheese.

The oldest member in longevity was Harold St. John (1911) who died December 12, 1991, at the age of 99 years and five months. The oldest current member is Wayne Manning (1934), who at 97 years answered the telephone in his office. Lyman Smith (1923) and Aaron Jack Sharp (1944) are both 92 at this writing (January 1997).

Bill Benninghoff, elected in 1940, died in 1993 and is buried in Arlington National Cemetery.

The gavel used by the President of the NEBC was turned from a "corner post" of Asa Gray's home on Garden Street.

The first field day of the NEBC was on May 30, 1911, to Providence, Rhode Island.

George Cooley (1953) fell into a volcano on St. Vincent, but his slide was stopped by grasping a bromeliad. He received an honorary Doctor of Science degree from the new University of South Florida before the school had awarded any degree.

Six members of the Club were presidents or chancellors of seven universities.

Edward Rand was called the Bard of the NEBC for his poem, "In the days of Walter Deane." It was sung to the tune of John Brown's Body. The text and other poems are printed in *Rhodora* (75: 493–516. 1973). Perhaps the most quoted poem in the archives is this joke on Arthur Stanley Pease (1902):

> Here lies the body of Stanley Pease
> Buried beneath the venerable trees
> What lies here is only the pod
> Pease shelled out and went to God.

No poet laureate for the NEBC has surfaced in recent years, but I felt this centenary deserved some poetic recognition. I'm not a poet, so I asked a friend in Acton who has notable talents in this area to prepare an ode for this occasion, the 100th anniversary. I close with these words supplied by Maurice Sagoff:

> If you've enjoyed the historical show
> You'll surely be pardoned for feeling a glow
> Of real satisfaction and well-deserved pride
> In what's been portrayed by each story and slide.
> So here's to our Club! Though a hundred years old,
> Its greater achievements have yet to be told.
> We count in our membership leaders in botany,
> Proven achievers; some clubs haven't got any.
> Members of fishing clubs may not have caught any.
> Hunt clubs don't care if you never have shot any.
> Teachers in unions may hardly have taught any.
> Even some legionnaires may not have fought any!
> But, to our credit, our workers in botany
> Truly have shown they are worthy of fame.
> I'll mention a dozen, at random, by name:
> There's Fernald and Merrill and Harris and Bean,

There's Bogle and Hodgdon and Walker and Pease,
Barrington, Weatherby, Nickerson, and Crow,
Eaton, and Knowlton and Ray Angelo;
If your name is not here with our sisters and brothers,
I'll add to the list the addendum—"and others."
Our members' professional writings abound
In volumes of vital research: we have found
Botanical treasures the world never knew
As well as a gaggle of trivia, too;
For instance, one member has found that Linnaeus
Once grumbled, "No matter how much they may pay us,
You can be sure that the wicked economy
Shortly will lay a tremendous Tax-on-o-me!"
(That derivation is open to question,
But someone will find a more valid suggestion.)

Now, is there a club that can mark its centenary
So free of corruption and scandal and venery?
Minds so devoted to pleasures botanic
That some of our spouses regard us as manic!
Some of this group are revisiting Harvard,
Some come to find out what's been lately "discarvered;"
Some meet their old colleagues and thump on their shoulder
And tell them they don't look a single bit older!
Some come to relax and perhaps get a snoot-full,
But for most, the occasion is sober and fruitful,—
A time to reflect on the glorious past,
And a time when our eye to the future is cast;
The next hundred years for the students of botany
Surely will chase any thoughts of monotony—
Challenges, problems, there will be no dearth
Of issues that threatened the health of the earth,
But well in the forefront of progress will be
The men and the women of the N.E.B.C.

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RHODORA, Vol. 98, No. 896, p. 459, 1996

BOOK REVIEW

Flora of Berkshire County, Massachusetts by Pamela B. Weatherbee. 1996. 135 pp. 48 color photos. ISBN 0-9648211-0-9. $20.00 (paper). Berkshire Museum, Pittsfield, MA.

This highly readable and accessible modern flora provides a wealth of information on the history, geology, floristics, vegetation communities and vascular plant species of Berkshire County. The habitat diversity of this 940-square mile region, which extends from Connecticut to Vermont, includes calcareous, serpentine, and metamorphic substrates and has a 2900-ft. elevation range, contributing to the occurrence of the 37 distinct plant communities for which Ms. Weatherbee provides comprehensive and detailed descriptions.

The book contains considerable information on each of the 1,675 taxa recorded from the county: whether native or introduced, frequency and abundance, habitats, flowering and fruiting dates and distribution within the county. Genera and species are in alphabetical order and nomenclature generally follows Kartesz. Eight color plates illustrate rare and uncommon species. Ms. Weatherbee also provides statistics on floristic change; exotics account for 27 percent of the taxa, and 35 native taxa and 107 aliens have migrated into the county since the last comprehensive survey in 1922. The book also includes a list of species which are occasionally observed but are nonpersistent.

I highly recommend this volume as a model for modern floristic treatments in New England. It provides a comprehensive picture of the flora of this complex segment of the region, and an engaging and well-written introduction to the habitat characteristics that account for species distributions and the occurrence of plant communities in western Massachusetts.

—Lisa A. Standley, VHB, Inc., P.O. Box 9151, 101 Walnut Street, Watertown, MA 02272.

RHODORA, Vol. 98, No. 896, pp. 460-462, 1996

BOOK REVIEW

Michigan Flora, Part III, Dicots (Pyrolaceae—Compositae) by Edward G. Voss. 1996. xix + 622 pp. 771 maps, 266 line drawings, 8 color plates. $15.00 (cloth). Cranbrook Institute of Science Bulletin 61 and University of Michigan Herbarium, Ann Arbor, MI.

Part of a project begun more than 40 years ago, this book completes a monumental study of the seed plants of Michigan. *Michigan Flora, Part III,* by Edward G. Voss, is an excellent book in an excellent series. *Part I* (Voss 1972) covered the gymnosperms and monocots, *Part II* (Voss 1985), the apetalous and polypetalous dicots, *Part III,* the sympetalous dicots. Save for the absence of the pteridophytes from the Michigan series, its three parts parallel both in coverage and family sequence the three volumes of Gleason's (1952) *New Britton and Brown Illustrated Flora.*

In the course of the requisite research for the three books, Voss studied more than a quarter million specimens collected from Michigan during the 19th and 20th centuries. He estimates that the number of Michigan specimens in the state's several herbaria has more than doubled over the past 40 years. A similar estimate would likely be valid for most states of the Midwest. In all, the three books contain county dot distribution maps for ca. 2,450 species, each dot substantiated by at least one of the herbarium specimens. The maps are rich with dots, and the distribution patterns they display are interesting and in some cases provocative. They remind one of the need for an atlas of plant distribution covering all the states of the *Gray's Manual* range (Fernald 1950).

Michigan Flora, Part III treats the plants of 33 dicot families, those of the large family Compositae or Asteraceae occupying about 40% of the taxonomic text. The text includes thorough, usually multi-charactered, dichotomous keys for species identification. The keys are often augmented by discussion of additional character-state differences, combinations, and nuances that further serve to distinguish the various species, hybrids, and infraspecific taxa. The comprehensive habitat statements will also, in some

cases, aid in the identification of unknowns. About one-third of the species are illustrated by habit sketches and/or drawings of diagnostic morphological details. The taxonomic section opens with eight plates of attractive color photographs of some 50 of the species. The section closes with a set of master keys to families and to special groups, e.g., aquatic plants, woody plants, covering all three parts of the *Michigan Flora.*

Nuggets abound in the discussion of individual genera and species. A few examples are: a brief history of the harvesting of floss from the seeds of common milkweed during World War II by the "Milkweed Floss Division of War Hemp Industries," headquartered at Petoskey, Michigan; the speculation that *Cynoglossum boreale* was the blue-flowered borage noted by Henry David Thoreau during his travels in Michigan in 1861; a discussion of the commercial growing of peppermint in Michigan, including notes on the establishment of the town of Mentha—whose post office closed in 1954; the observation that in most Michigan species of *Viburnum* a fruit is purple-black when mature, "although it may be red when it is green" (ouch!); some thoughts on the gender of the generic name *Bidens*; a discourse on taxonomic problems in the genus *Aster*; and the comments on the "tragic spread" of the European thistle *Cirsium palustre* into natural wetlands.

The three-part *Michigan Flora* will be of great value to professional botanists and botany students dealing with plants of the Midwest, the Northeast, and Ontario. It will be of great utility to all individuals whose interest or work brings them into contact with the region's plant life, such as those concerned with the identity of plants growing in wetlands or lakes, the occurrence of trees or wildflowers, the relationship between plants and insects or between plants and soils, and the preservation of rare species or important natural areas. "A flora," as Voss writes, "is an inventory or census of a basic resource."

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—Tom S. Cooperrider, Department of Biological Sciences, Kent State University, Kent, OH 44242

Note: Parts I and II are available for $12.50 each from the Cranbrook Institute of Science, 1221 N Woodward Ave., P.O. Box 801, Bloomfield, MI 48303-0801 (phone 810-645-3239 or 810-645-3203).—*Ed.*

RHODORA, Vol. 98, No. 896, pp. 463–467, 1996

NEBC MEETING NEWS

September 1996. Pamela Weatherbee spoke on "Mount Greylock, Haven for the Berkshire Flora." Although it may be the world's smallest mountain, Greylock has a long and interesting history and an unusual flora. The mountain rises abruptly 2800 feet in elevation from the valley floor, resulting in sharp distinctions between vegetation zones and severe summit weather. The geology of Mount Greylock is responsible for much of the diversity of the flora. The hard, resistant and somewhat acidic schists on the summit provide a very different substrate from the calcareous marbles along the mountain's flanks.

After reviewing the history of the mountain, Pam led the Club on an armchair tour of the diverse plant communities on Mount Greylock, starting at the summit where northern species such as *Sorbus decora, Amelanchier bartramiana, Solidago macrophylla, Euphrasia, Streptopus amplexicaulis, Ledum groenlandicum, Betula cordifolia,* and the state's only *Vaccinium vitis-idaea* occur. Boggy areas near the summit support *Milium effusum* and *Gaultheria hispidula.*

In the Northern Hardwoods zone, species include *Platanthera macrophylla, P. grandiflora, P. lacera* and their hybrid, *P.* × *andrewsii,* in addition to more typical herbaceous and shrub species. The rich sugar maple forests on marble support a very diverse herbaceous flora, including wild leeks, *Dicentra, Hepatica, Viola canadensis* and *V. rostrata, Disporum, Caulophyllum, Uvularia grandiflora, Orchis spectabilis, Panax quinquefolius, Hydrophyllum canadense, Conopholis, Botrychium matricariifolium,* and *Camptosorus,* as well as the hairy woodmint.

Steep ravines are a high-disturbance zone, and support *Ribes lacustre, R. triste, Conioselenium chinense,* and *Polystichum braunii* along the cold, rushing brooks. Cliffs provide habitat for *Woodsia glabella, Cryptogramma,* and *Potentilla tridentata.*

September Field Trip. On Saturday, September 14th, 20 NEBC members and guests met at the summit of Mount Greylock, in the fog, to experience the flora described at the Club meeting. Led by Pam Weatherbee, we started with "parking lot" botany at the summit where, accompanied by a cellist, we saw *Sorbus decora* in fruit (and compared it to *S. americana*), *Ame-*

lanchier bartramiana, wind- and ice-shaped balsam firs, and *Euphrasia* in bloom. The sole site of *Vaccinium vitis-idaea* in Massachusetts was observed on the drive to the "boreal forest" zone, where the group was introduced to *Betula cordifolia, Dryopteris campyloptera, Solidago macrophylla, Carex intumescens,* and *Aster acuminatus. Carex gynandra, C. trisperma, Chelona glabra,* and *Nemopanthus mucronatus* in fruit were highlights of a small summit bog, along with two sharp-shinned hawks. A wet glade in the "northern hardwoods" forest lower down the mountain provided *Glyceria melicaria, Carex scabrata, Milium effusum, Laportea, Ribes triste,* and *Cinna latifolia.* The final highlights of the trip were along a steep stream ravine, where we found *Solidago flexicaulis, Ribes lacustre, Caulophyllum thalictroides, Allium tricoccum, Asarum canadense, Phegopteris hexagonoptera,* a two-lined salamander, and (growing together) *Polysticum acrostichoides, P. braunii,* and their hybrid, *P.* × *potteri.*

October 1996. Dr. Thompson Webb III of Brown University spoke on "Vegetational History of New England and Eastern North America: a 20,000 year perspective." The talk was based on a recently published book, *Global Climate since the Last Glacial Maximum,* produced by the Cooperative Holocene Mapping Group and edited by Herb Wright. The book integrates vegetation data derived from pollen analyses with climatic data from lake levels to produce computer simulations of climate that are useful both in documenting the past and providing a test for predictive climate models.

Pollen analyses have some severe limitations for understanding vegetation. Since these are based on anemophilous species, pollen records show only a small portion of the flora and may represent species from several plant communities. Recent work has shown that the relative abundance of tree species and pollen deposition correlate best at the continental scale, where climate is the most important factor controlling plant distribution. A quick overview of the history of New England flora shows that spruce and pine dominated the vegetation before about 9000 years ago, with oak and pine more recent dominants. Ragweed pollen appeared following the European colonization and land clearing, and is probably the first source of New World air pollution.

Pollen data show that plant associations were very different at past times than we know them today, and that distributions have

changed substantially. Spruce/fir forests, for example, have occurred only recently. Following the last glaciation, species did not simply migrate south and north in response to the advancing and retreating glaciers, but individually responded to changes in climate. Some species were rare everywhere at the glacial maximum but increased in abundance after glaciation, spreading along the glacial front.

Dr. Webb concluded the presentation with dynamic representations of the change in plant distributions over time, using a video film of a computer 3-dimensional model.

November 1996. The Centennial Banquet was held at the Harvard Faculty Club with 85 members and guests present, including six who had been members for over 50 years.

Dr. Richard Howard, a member since 1940, spoke on "An Illustrated History of the New England Botanical Club." Former Director of the Arnold Arboretum and Science Director at the New York Botanical Garden, as well as Past President of the NEBC, Dr. Howard was the featured speaker at the 700th and 800th meetings of the Club and holds the record for speaking at commemorative Club milestones. Dr. Howard provided an overview of the environment in which the Club emerged. Many of the extant scientific organizations have their roots in this period, including the American Philosophical Society, AAAS, the Massachusetts Horticultural Society, and the Massachusetts Audubon Society. The NEBC is unusual in that it has operated for a century without a change in name or organization.

Key prior organizations included the Linnaean Society of New England, which became the Boston Museum of Natural History and eventually was re-established as the Museum of Science. Natural history societies were founded in several locations, including the Essex County Natural History Society which merged with the Essex Institute, and later became the Peabody-Essex Museum. Others included the Agassiz Association, which began in Lenox and comprised 20,000 members worldwide at its peak but expelled members who failed to supply exchange specimens, the Cambridge Science Club, the Torrey Botanical Club (the oldest botanical club), the Connecticut Valley Botanical Society, the American Botanical Club (now the Botanical Society of America), and the Josselyn Botanical Society, founded in 1895 with Kate Furbish as Vice President. This was an era of intense interest

in the local flora. Mary Day, the legendary Gray Herbarium librarian, identified 61 private herbaria in New England in the early 1900s, and Robinson cited 365 individual local floras in his edition of *Gray's Manual.*

The New England Botanical Club was founded a year later, in 1896. The Club's founders, particularly George Goodale, had all been involved in other local scientific clubs and organizations. The goals of the founders were to organize a club to study the New England and alpine flora. The name of the Club's journal, *Rhodora,* was deliberately chosen to correspond with the goal of studying the flora in the natural range of *Rhododendron canadense.* Dr. Howard provided brief sketches of each of the Club's founding members. Among these gentlemen were: J. R. Churchill, a judge and banker; W. G. Farlow, to whom we owe the current old herbarium building (he left his collection to Harvard on the condition that it be moved to a fireproof building); C. E. Faxon, who drew the plates for Sargent's *Silva of North America,* despite his training as an engineer; G. L. Goodale, who was a highly successful fundraiser and apparently tireless teacher; E. L. Rand, who focused on Mt. Desert; C. S. Sargent, who served as Director of the Arnold Arboretum for 54 years; R. Thaxter, the first Club President to offer travel talks; and B. M. Watson, credited with introducing the Japanese honeysuckle.

Dr. Howard concluded with an eclectic list of NEBC trivia and doggerel, to the appreciation and amusement of those present.

December 1996. Dr. David Barrington of the University of Vermont concluded the Centennial Year presentations with a talk entitled "What We Don't Know About the New England Flora and Why We Want To Know It." Some of the major unknown areas of the New England flora are those that first interested the founders of the Club—disjunctions in distributions and the origins of the flora. Using examples from research in his lab, Dave showed how modern techniques are expanding our knowledge of the evolution of New England taxa through both reticulate and divergent evolution, resolving old taxonomic problems and shedding light on evolutionary origins.

Examples that Dave discussed include the tetraploid/diploid complex within *Asplenium trichomanes,* the two allotetraploids *Cystopteris tenuis* and *C. fragilis,* the serpentine endemic allotetraploid within the *Adiantum pedatum* complex, the as-yet unre-

solved relationships within the *Diphasiastrum complanatum/digitatum* complex, and the evolution of genetically distinct groups within the *Ammophila breviligulata* complex. In each of these cases the application of new theories of systematics and new and powerful molecular tools has, in combination with detailed morphological studies, allowed us to understand the evolutionary relationships and history of the taxa in the New England flora. In several instances, however, this has created problems for the conservation of biological diversity, when science recognizes taxa that are evolutionarily distinct but morphologically cryptic.

—Lisa A. Standley, Recording Secretary.

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1996

The editors of *Rhodora* are grateful to each of the following specialists for their participation in the review process.

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FLORAS AND TAXONOMIC TREATMENTS: Specimen citation should be selected critically, especially for common species of broad distribution. Keys and synonymy for systematic revisions should be prepared in the style of "A Monograph of the Genus *Malvastrum*,"

S. R. Hill, RHODORA 84: 159–264, 1982. Designation of a new taxon should carry a Latin diagnosis (rather than a full Latin description), which sets forth succinctly how the new taxon differs from its congeners.

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THE NEW ENGLAND BOTANICAL CLUB
22 Divinity Avenue
Cambridge, MA 02138

The New England Botanical Club is a nonprofit organization that promotes the study of plants of North America, especially the flora of New England and adjacent areas. The Club holds regular meetings, and has a large herbarium of New England plants and a library. It publishes a quarterly journal, RHODORA, which is now in its 99th year and contains about 400 pages per volume. Visit our web site at http://www.herbaria.harvard.edu/nebc/

Membership is open to all persons interested in systematics and field botany. Annual dues are $35.00, including a subscription to RHODORA. Members living within about 200 miles of Boston receive notices of the Club meetings.

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